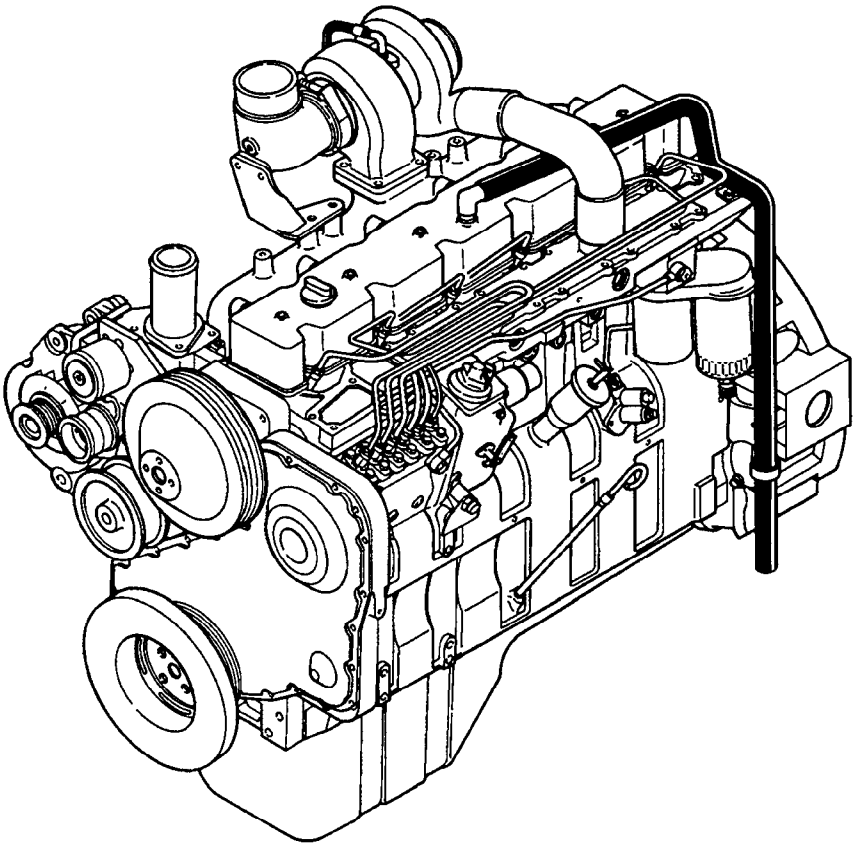
CEBM614SH0

KDC 614 SERIES ENGINE SHOP MANUAL 1991 SERIES



KOMATSU

[Rev. A]

How To Use This Manual

Table of Contents

The Table of Contents in the front of the manual contains a quick page reference for each group number.

Group Contents

Each group contains the following information:

- A group index page at the beginning of each group to quickly aid in locating the information desired.
- General information to aid in rebuilding the component and an explanation of design change differences.
- Step-by-step rebuild instructions for disassembly, cleaning, inspection, and assembly of the component.
- Symbols which represent the action outlined in the instructions. The definitions of the symbols, appear on pages i-5 through i-8.

Index

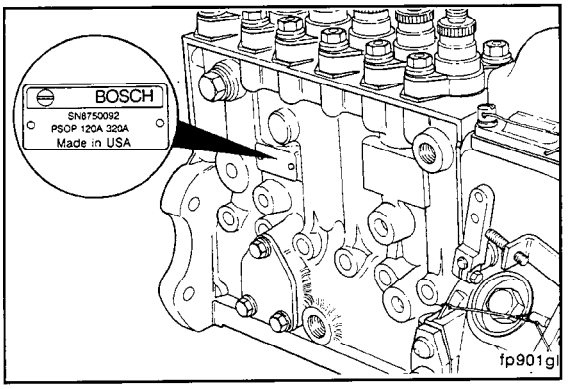
An alphabetical index is in the back of the manual to aid in locating specific information.

Metric Information,

Both metric and U.S. customary values are used in this manual. The metric value is listed first, followed by the U.S. customary in brackets. An example is 60°C [140°F].

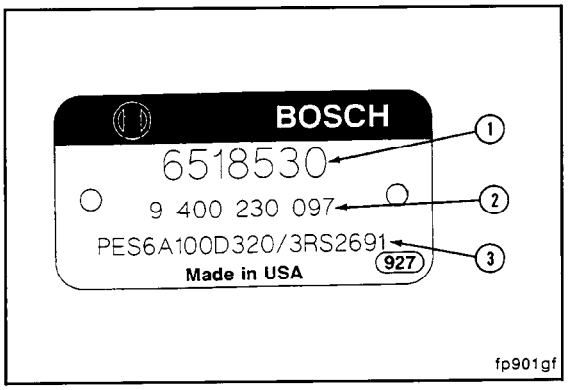
Fuel Injection Pump Dataplate

The injection pump dataplate is located on the side of the injection pump. It provides information for fuel pump calibration.

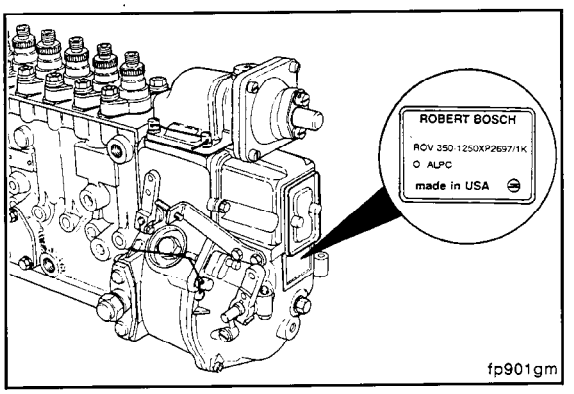


The Bosch Injection pump dataplate contains:

1. Pump Serial Number
2. Bosch Ten Digit Number
3. Bosch Designation Code

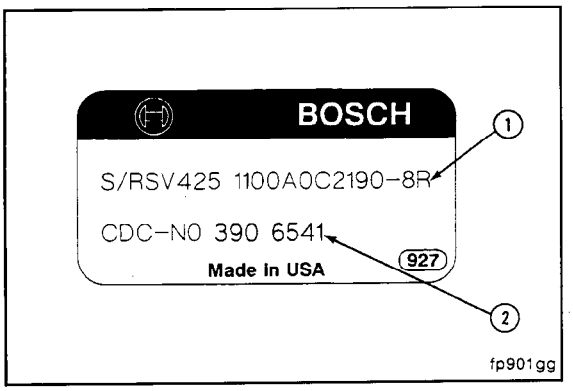


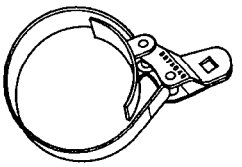
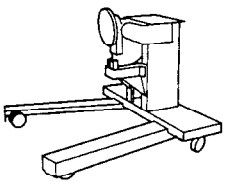
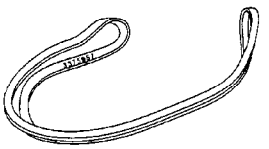
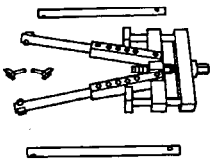
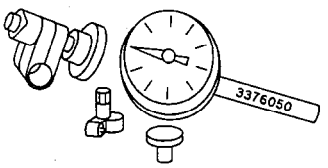
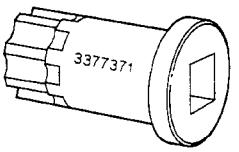
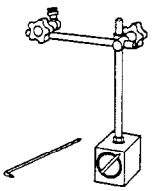
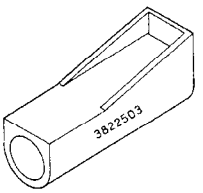
The vendor part number for the fuel pump-governor combination is located on the governor dataplate.



The Bosch governor dataplate contains:

1. Bosch Governor Designation Code.
2. Vendor Pump Part Number

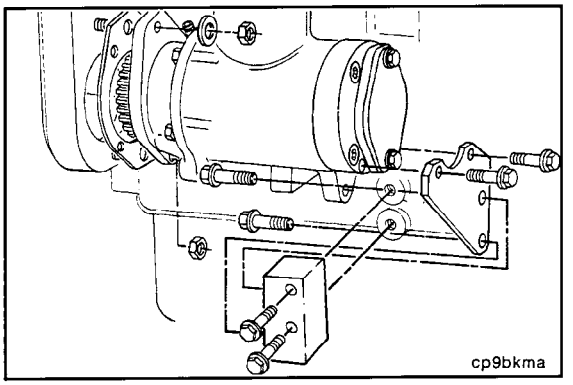


Tool No.	Tool Description	Tool Illustration
3375049	**Oil Filter Wrench** Used to remove and install lubricating oil filter.	
3375194	**Engine Rebuild Stand** Support cylinder block during engine rebuild. Used with Part No. 3822607, Adapter Plate.	
3375957	**Nylon Lifting Sling** Aid in removal and installation of crankshaft, flywheel and other heavy components.	
3376015	**Universal Cylinder Liner Puller** Remove cylinder liners from the cylinder block. Requires two of Part No. 3376649, Puller Arm Extension Feet.	
3376050	**Dial Indicator and Sleeve Assembly** Use with Part No. ST-1325 Dial Gauge Attachment to measure flywheel and flywheel housing runout. Use with Magnetic Base, Part No. 3377399, to measure gear end clearance and backlash.	
3377371	**Engine Barring Tool** Used to rotate the crankshaft.	
3377399	**Magnetic Base Dial Indicator Holder** Used with Part No. 3376050, Dial Indicator and Sleeve Assembly.	
3822503	**Cylinder Liner Clamp Set (includes two clamps)** Used to clamp the liner into the bore of the cylinder block. Note: Requires two cylinder head capscrews (not included in the clamp set).	

19 mm, 15 mm, 14 mm

Remove the air compressor support bracket and capscrews.

Remove the air compressor.

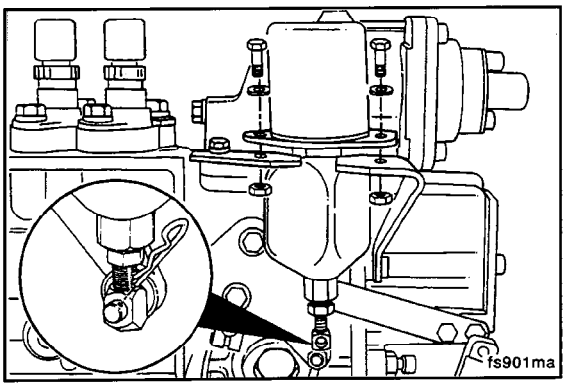


Fuel Pump Solenoid - Removal

10 mm

Disconnect the fuel shutoff solenoid wiring.

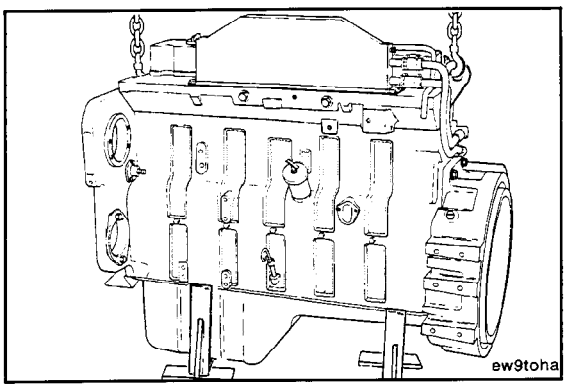
Remove the hitch pin clip, mounting capscrews and fuel shutoff solenoid.



Engine - Installation onto Engine Rebuild Stand

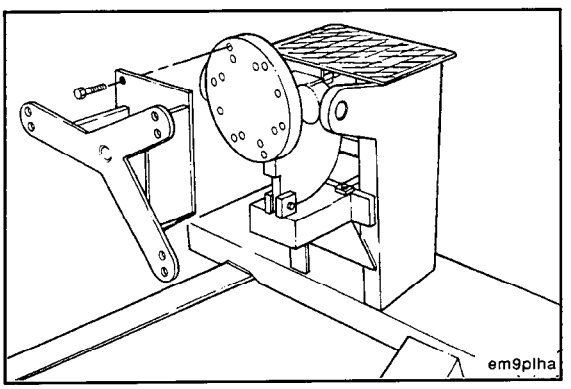
Part No. 3822512 Engine Lifting Fixture

NOTE: The dry weight of the engine is 606 kg [1335 lb]. Use an engine lifting bracket, such as Part No. 3822512, to lift the engine.



Use four (1/2 x 13 x 1-1/2 inch) grade 5 capscrews to install the Part No. 3822607, Adapter Plate, onto the Part No. 3375194, Engine Rebuild Stand.

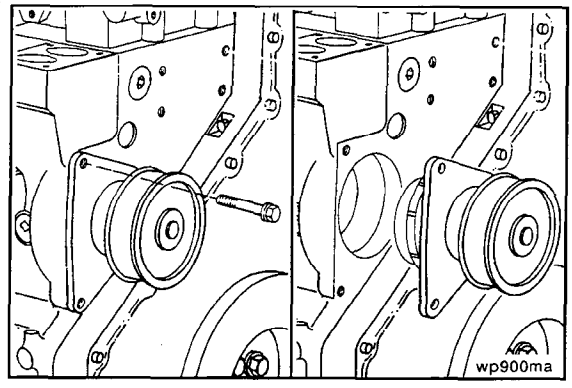
Torque Value: 95 N•m [70 ft-lb]



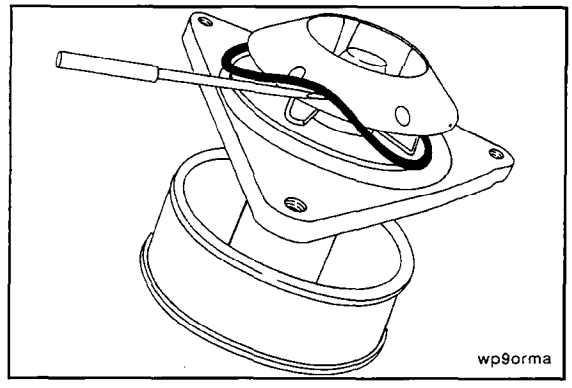
Water Pump - Removal

13 mm

Remove the water pump.

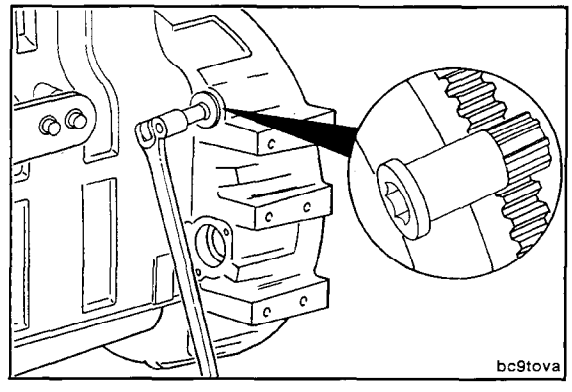


Remove and discard the o-ring.



Part No. 3377371 Engine Barring Gear

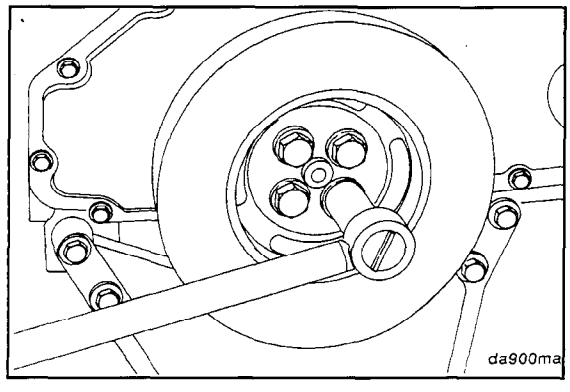
Use the engine barring tool to prevent the engine from rotating when loosening the damper capscrews.



Vibration Damper - Removal

21 mm

Remove the vibration damper.

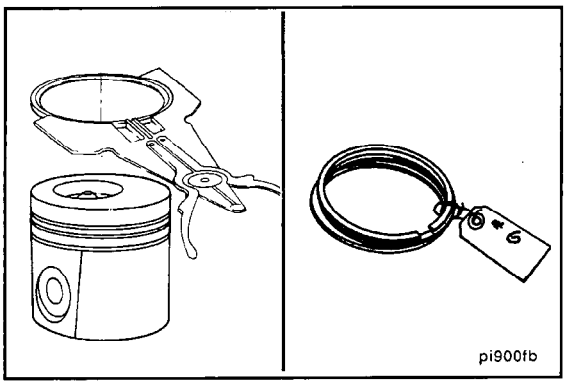


Piston Ring - Removal

Part No. 3823137 Piston Ring Expander

Use piston ring expander, Part No. 3823137, to remove the piston rings.

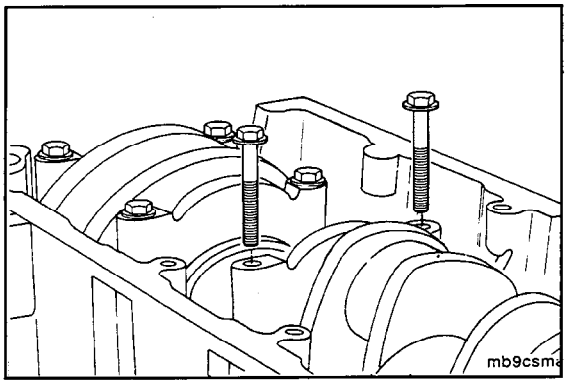
Place a tag on the piston rings and record the cylinder number of the piston on the tag.



Main Bearing Cap - Removal

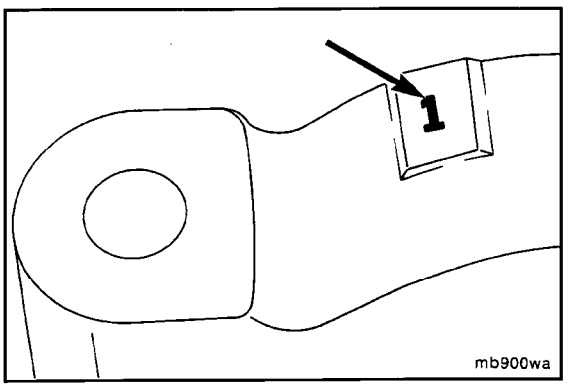
19 mm

Rotate the engine to a horizontal position and remove the main bearing cap capscrews.



The main bearing caps should be numbered.

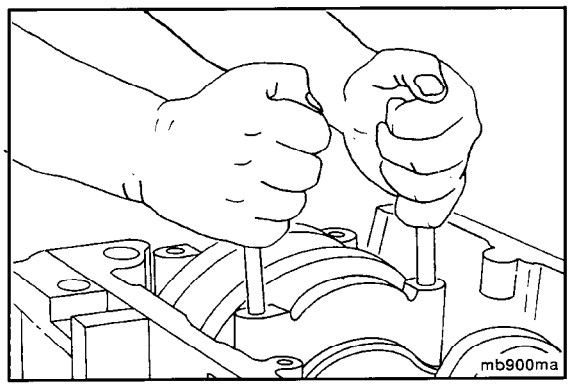
Use a steel stamp to mark any main bearing caps without a number before the main bearing cap is removed.



Remove the main bearing caps.

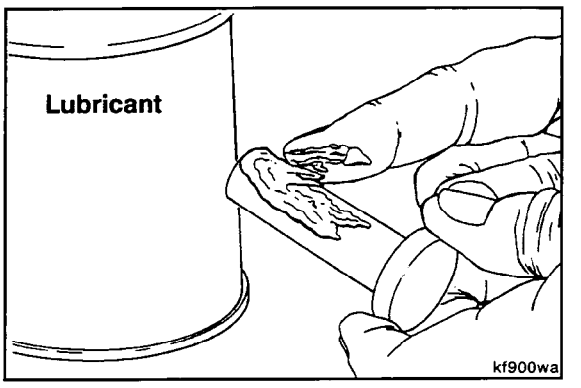
Do not pry on the main bearing caps to free them from the cylinder block.

Use two main bearing cap capscrews to "wiggle" the main bearing cap loose, being careful not to damage the capscrew threads.



Lubricate the tappet heads, stem and sockets with Lubriplate™ 105.

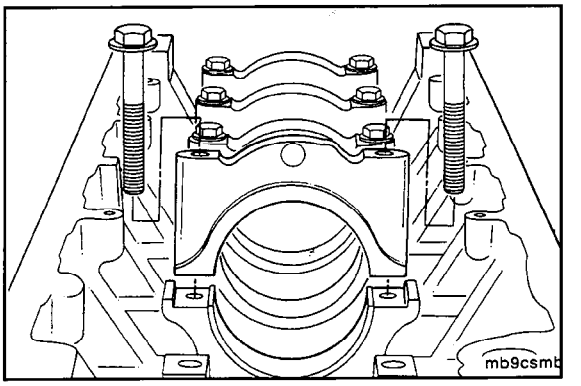
Install the valve tappets.



Piston Cooling Nozzle - Installation

23 mm

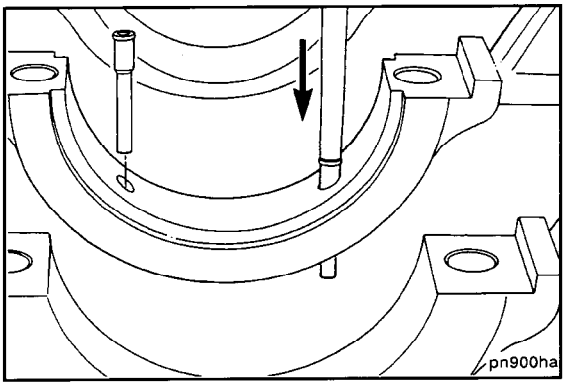
Remove the main bearing caps.



1/2 Inch Center Punch

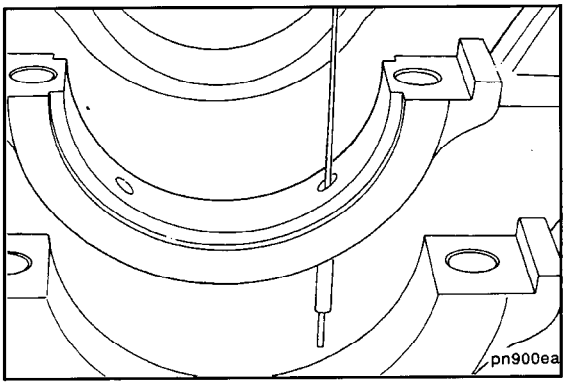
Install the piston cooling nozzles even with or below the bearing saddle surface.

NOTE: Due to the positioning and spray angle of the nozzles, there are no bores needed for the No. 3 main bearing saddle.

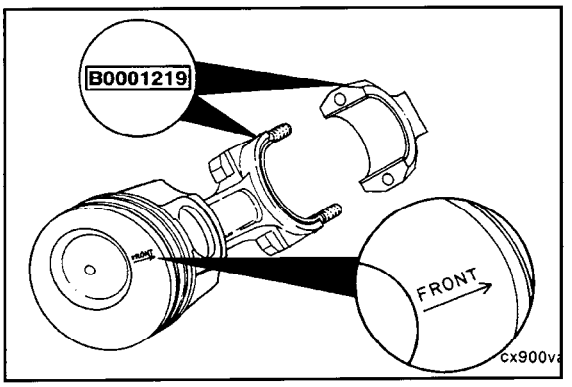


Be sure spray holes are clean and open.

NOTE: Be sure the piston cooling nozzle hole is **not** damaged during cleaning.



Caution: Be sure "Front" marking on piston and the numbers on the connecting rod and connecting rod cap are oriented as illustrated.



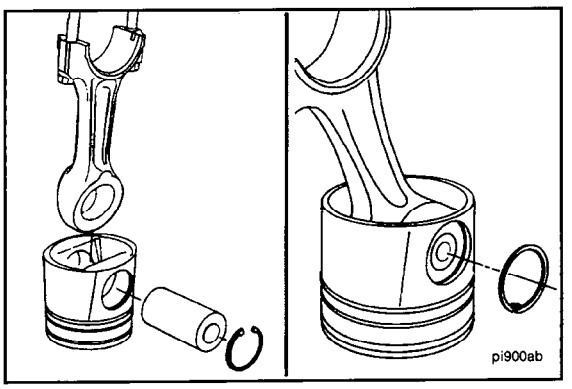
Snap Ring Pliers

NOTE: Pistons do not require heating to install the piston pin; however, the pistons do need to be at room temperature or above.

NOTE: The retaining ring **must** be seated completely in the piston pin bore to prevent engine damage during engine operation.

Install a new retaining ring into the piston pin bore.

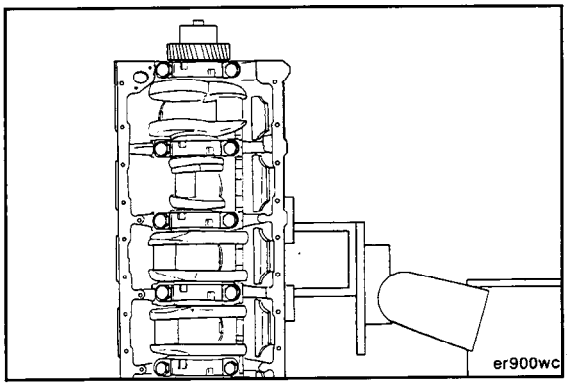
Align the piston pin bore of the connecting rod with the piston pin bore of the piston and install the piston pin. Install the second retaining ring.



Piston Ring End Gap - Measurement

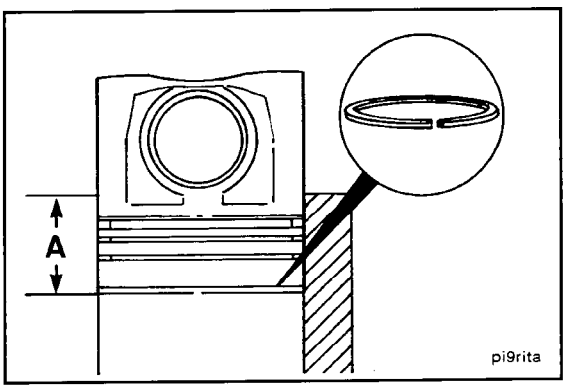
Rotate the engine on the rebuild stand until the crankshaft is vertical and the crank gear is facing upward.

NOTE: If the engine is rotated more than 90 degrees, the valve tappets can fall out.



To check the piston ring gap, use the top end of a piston to align the piston rings in the wear area of the cylinder liner in which they will be used.

A = 89 mm [3.5 inches]



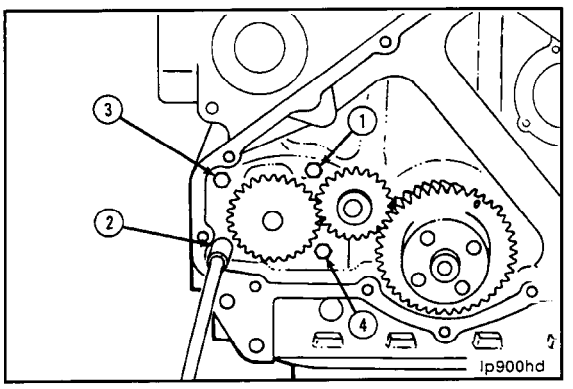
13 mm

Tighten the lubricating oil pump capscrews in the sequence shown.

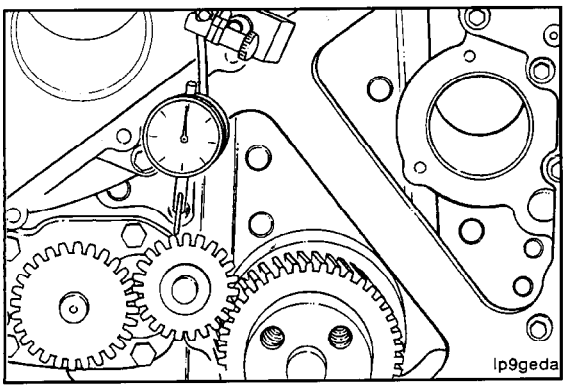
Torque Value:

Step 1 - 5 N•m [44 in-lb]

Step 2 - 24 N•m [18 ft-lb]



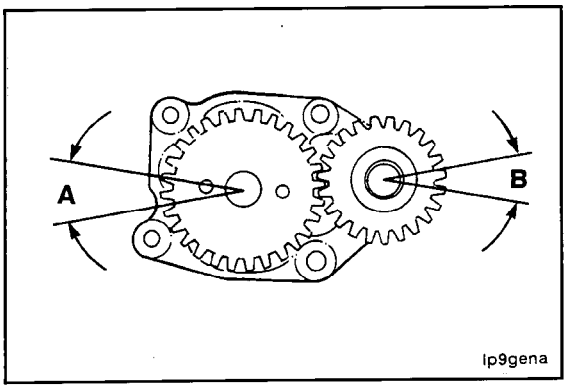
Use a dial indicator with a magnetic base to measure the idler gear backlash.



Measure the gear backlash.

NOTE: Hold the adjoining gears from moving when checking backlash or the reading will be the total of both gears.

Oil Pump and Idler Gear Backlash (A & B)		
mm		**in**
0.08	MIN	0.003
0.45	MAX	0.018

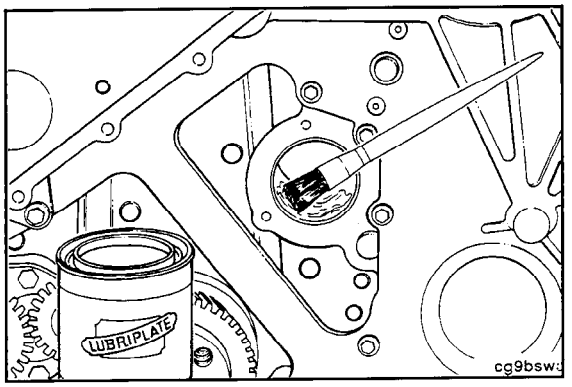


Camshaft - Installation

Lubricate the camshaft bores with Lubriplate™ 105.

Refer to Group 01 for camshaft bushing installation.

Service Tip: The crankshaft should be positioned with the No. 1 cylinder at approximately top dead center (TDC), so the camshaft does **not** hit the crankshaft counterweights during installation.



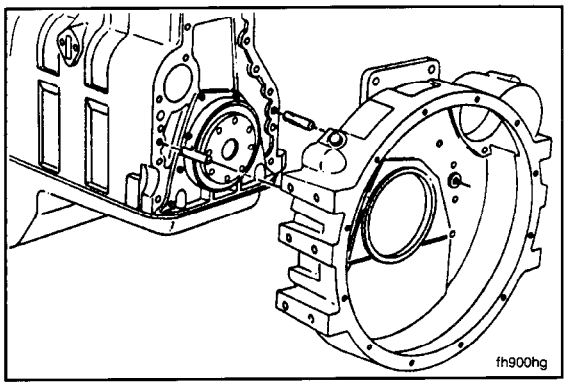
If the intersection point falls outside the shaded area, the ring dowels **must** be removed and the housing repositioned.

The ring dowels are **not** required to maintain concentricity of the housing. The clamping force of the capscrews holds the flywheel housing in position.

After the ring dowels are discarded, install the flywheel housing on the engine.

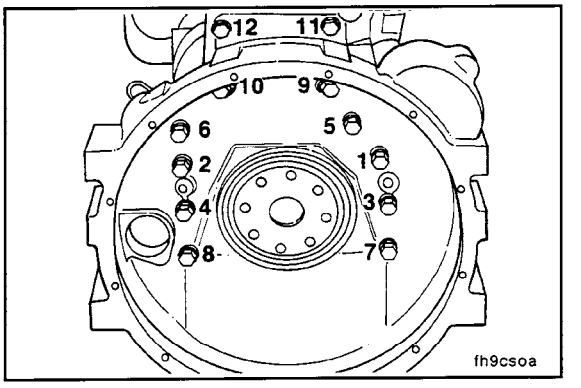
To position the housing, tighten the capscrews enough to hold the flywheel housing in place, but loose enough to enable small movement when struck lightly with a mallet.

Check the concentricity again by following the above procedure.



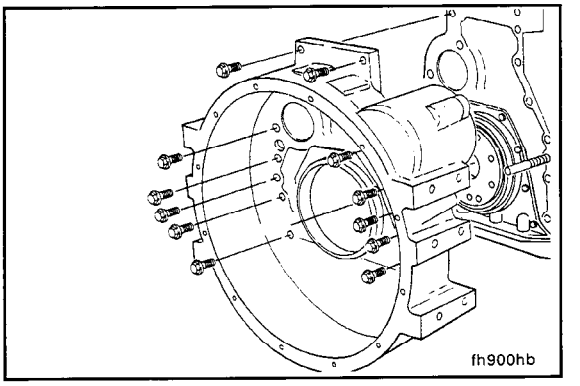
Use the pattern shown in the chart to install and tighten the mounting flywheel housing capscrews.

Torque Value: 60 N•m [45 ft-lb]



Wet Clutch Application

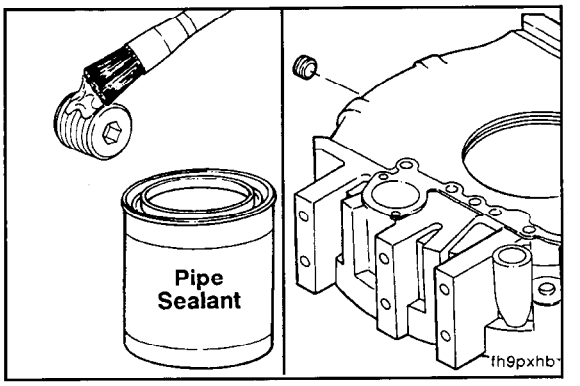
Perform all the steps in the procedure for dry clutch installation in addition to the following:



Coat the flywheel housing drain plug with pipe sealant and install in the hole in the bottom of the flywheel housing.

Tighten the drain plug.

Refer to the pipe plug torque values in Group 18 for different plug sizes.

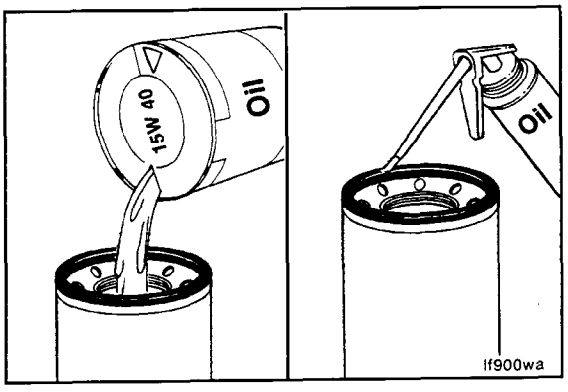


Lubricating Oil Filter - Installation

Apply a light film of clean 15W-40 engine oil to the gasket sealing surface before installing the filter.

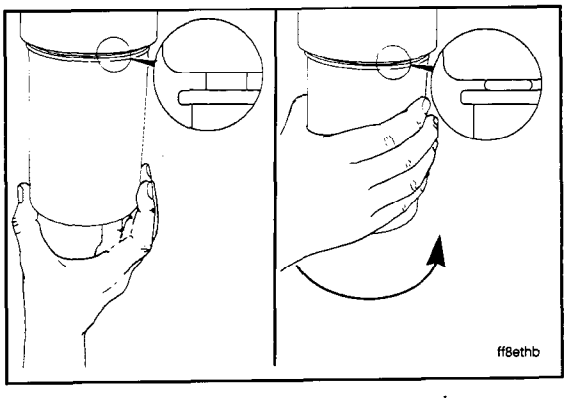
NOTE: The filter must be installed within 15 minutes from the time oil was applied to the rubber seal.

Fill the oil filter with clean 15W-40 engine oil.



Caution: Mechanical over-tightening may distort the threads or damage the filter element seal.

Install the filter as specified by the filter manufacturer.



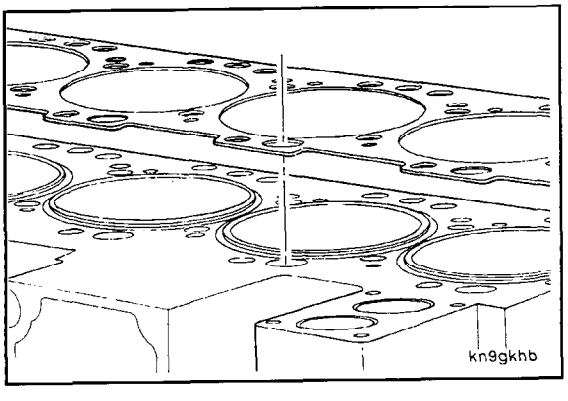
Cylinder Head - Installation

The cylinder block and head **must be** clean and dry.

NOTE: The maximum allowable piston protrusion above the top of the block with a standard gasket is 0.40 mm [0.016 inch]. If the piston protrusion is greater than specified, refer to Group 01 for information pertaining to thicker head gaskets.

Make sure the gasket is correctly aligned with the holes in the cylinder block.

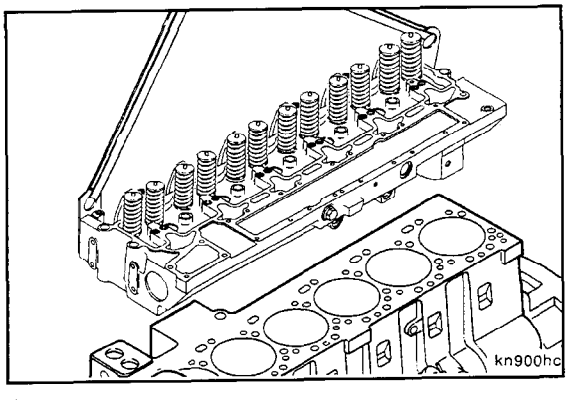
Position the gasket onto the dowels.



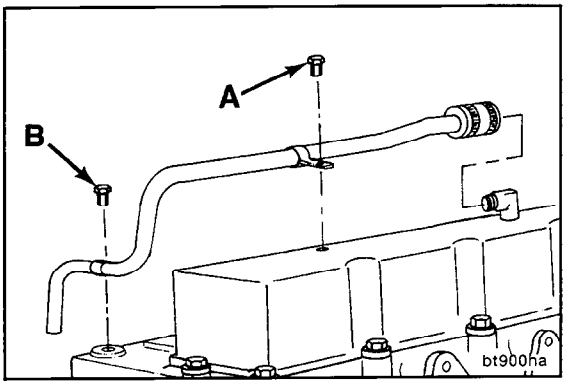
The component weighs 23 kg [50 lb] or more. To avoid personal injury, use a hoist or get assistance to lift the component.

Caution: Do not drop the cylinder head on the cylinder head gasket. The gasket material will be damaged.

Carefully install the cylinder head onto the gasket and cylinder block. **Make sure the cylinder head is installed onto the dowels in the cylinder block.**



Crankcase Breather Tube - Installation



13 mm, 18 mm

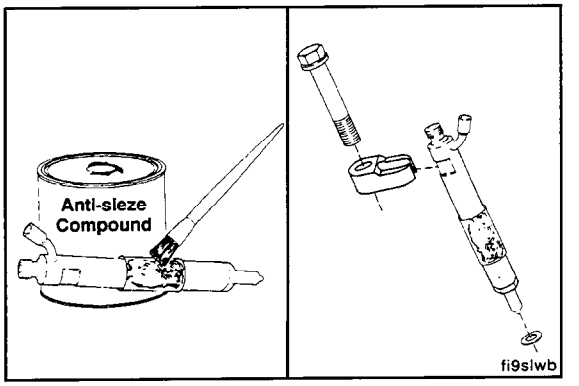
Install the breather tube and hose clamps. Tighten the capscrews for the breather tube support brackets.

Torque Value:

A = 24 N•m [18 ft-lb]

B = 43 N•m [32 ft-lb]

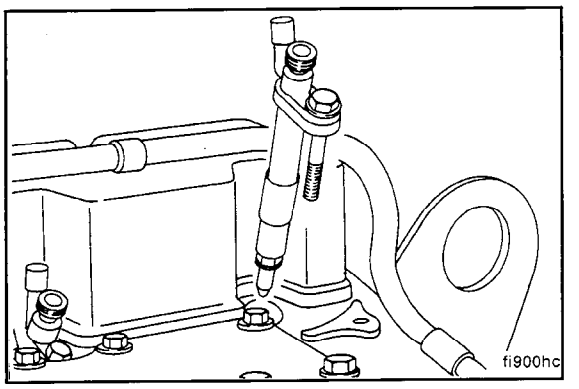
Injector - Installation



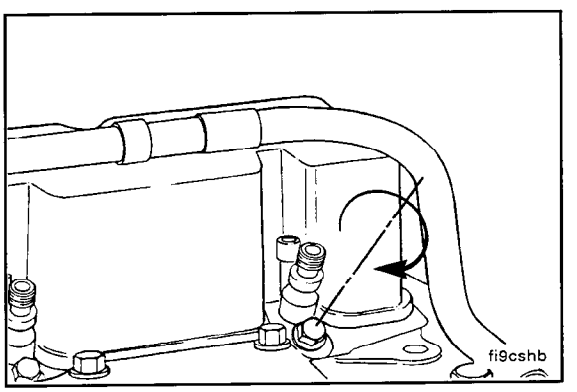
Lubricate the sealing lips of the sleeve with anti-seize compound. Assemble the injector, sealing sleeve, a new copper sealing washer and the holddown clamp.

Use only one washer.

Service Tip: A light coat of clean 15W-40 engine oil between the washer and injector will aid in holding the washer in place during installation.



Install the injector assembly into the injector bore. The injector leak-off connection **must** be toward the valve cover.



13 mm

Install the holddown capscrew.

Torque Value: 24 N•m [18 ft-lb]

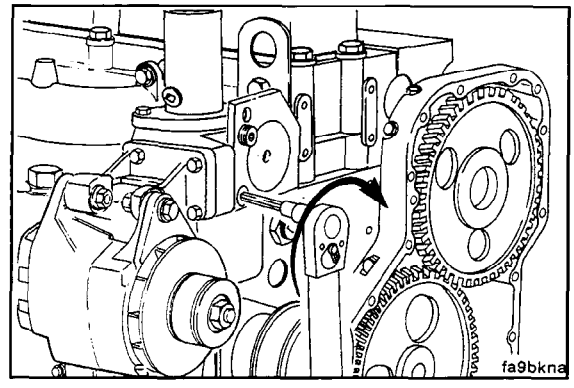
Belt Tensioner Bracket - Installation

5 mm Hex Wrench

Install the tensioner bracket onto the front of the thermostat housing.

Tighten the hex head screws.

Torque Value: 24 N•m [18 ft-lb]

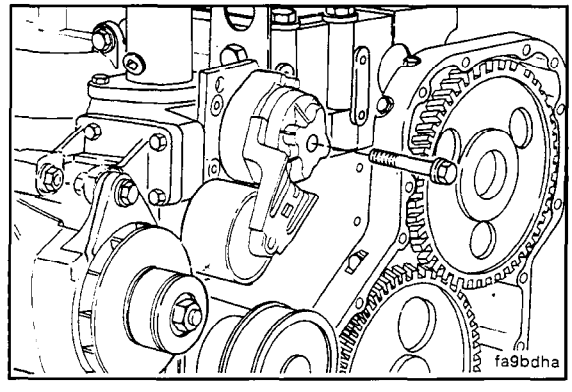


Belt Tensioner - Installation

15 mm

Position the belt tensioner onto the bracket and secure it with the capscrew. Make sure the tensioner locating tab is positioned in the unthreaded hole of the tensioner bracket.

Torque Value: 43 N•m [32 ft-lb]



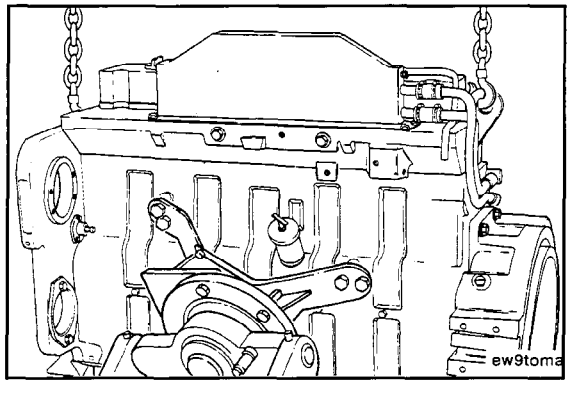
Engine - Removal from the Rebuild Stand

Part No. 3822512 Engine Lifting Fixture

Warning: To prevent personal injury, the engine lifting equipment must be designed to safely lift the engine as an assembly. The dry weight of the engine with standard accessories is 606 kg [1335 lb].

Use a properly rated hoist and engine lifting fixture such as Part No. 3822512, attached to the engine mounted lifting brackets to lift the engine.

Warning: The engine can move or drop a small distance as it is being removed from the rebuild stand. Use extreme care to prevent personal injury.

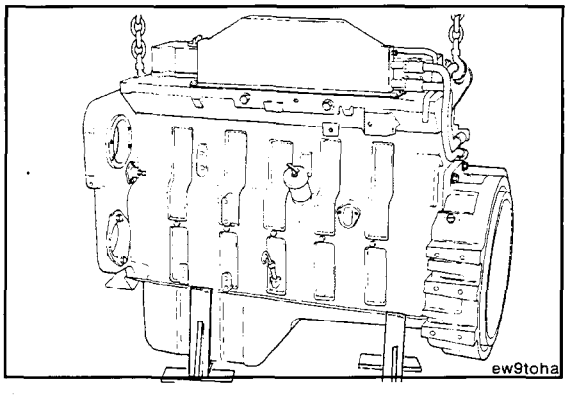


Use the hoist and lifting fixture to apply lifting tension to the engine.

Remove the six capscrews that hold the engine to the adapter plate.

Use the hoist to lower the engine to suitable engine support stands or a shipping skid.

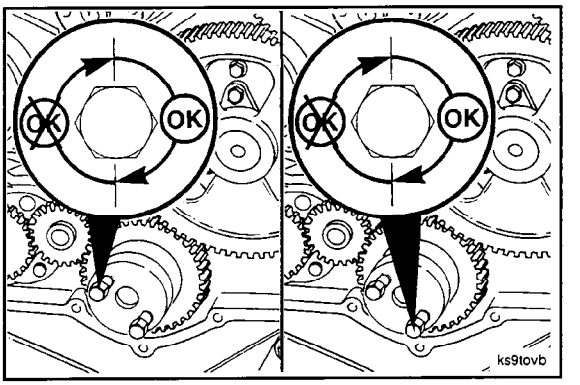
Remove the hoist and lifting fixture from the engine.



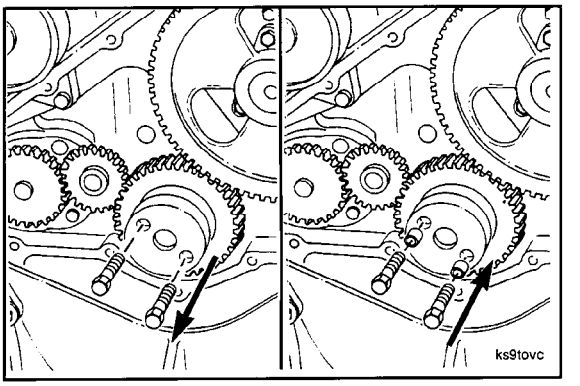
Alternately tighten the capscrews until the sleeve is installed to a depth of approximately 16 mm [0.625 inch].

NOTE: To prevent damage to the wear sleeve, do not exceed 1/2 revolution of each capscrew.

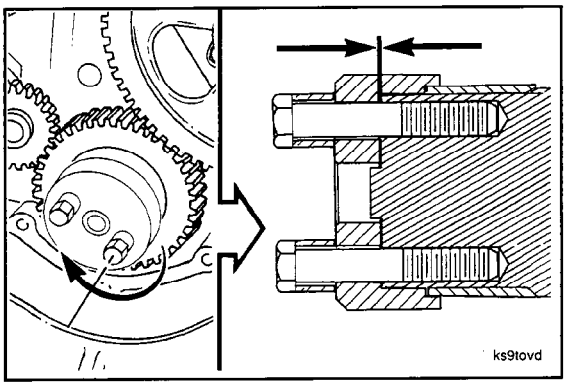
Approximate torque value: 20 N•m [15 ft-lb]



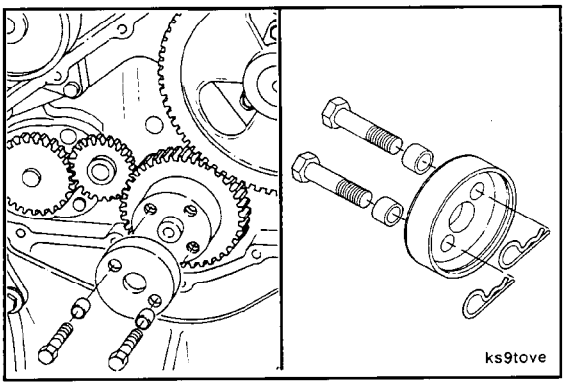
Remove the capscrews and install a spacer on each capscrew. Install the two capscrews again.



Continue to alternately tighten the capscrews until the bottom of the driver contacts the end of the crankshaft.

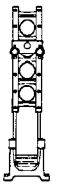
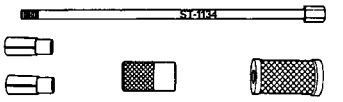
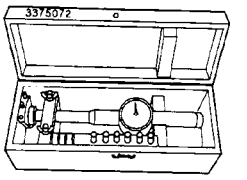
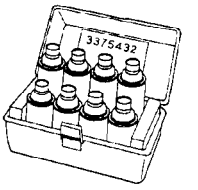
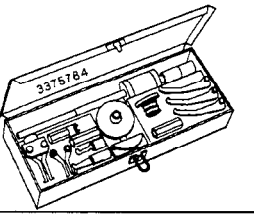


Remove the driver. Use the hair pin cotters to secure the capscrews and spacers to the tool during storage.

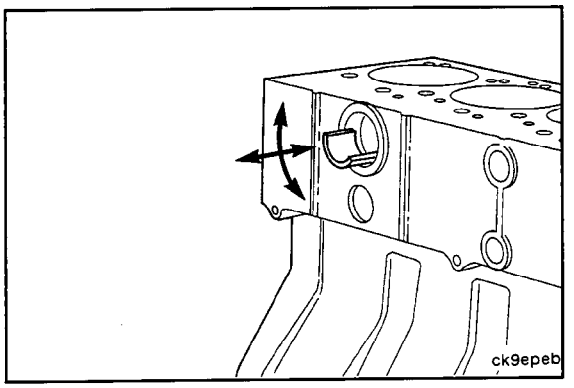


Cylinder Block - Service Tools

The following special tools are recommended to perform procedures in Group 01. The use of these tools is shown in the appropriate procedure. These tools can be purchased from your local Distributor.

Tool No.	Tool Description	Tool Illustration
ST-561	**Connecting Rod Checking Fixture** Measure connecting rod length, twist and bore alignment. Use with Part No. 3823286, connecting rod checking mandrel kit.	
ST-1134	**Dowel Pin Extractor** Remove dowel pins.	
3375068	**Cup Plug Sealant** Used when installing pipe plugs, cup plugs, etc. on the engine to prevent leaks.	
3375072	**Dial Bore Gauge Kit** Used to measure internal diameter bores from 78.5 mm [3.09 in] to 2.032 mm [8.0 in].	
3375432	**Crack Detection Kit** Inspect components for cracks.	
3375432	**Light Duty Puller** Used to remove expansion plugs.	

Thoroughly clean all expansion plug bores with a Scotch Brite® 7448 cleaning pad, or equivalent, and solvent.

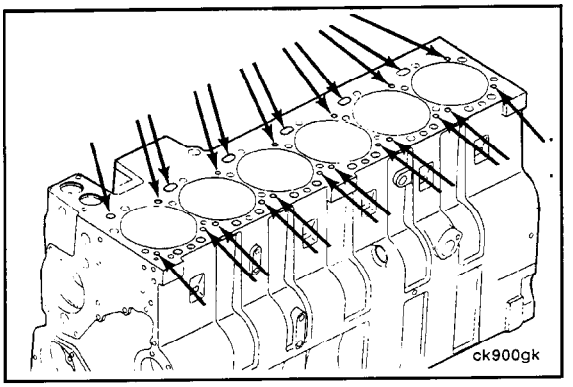


Inspect the coolant passages for rust or restriction. Use bristle brushes to clean the coolant passages.

Warning: Use protective measures to prevent personal injury.

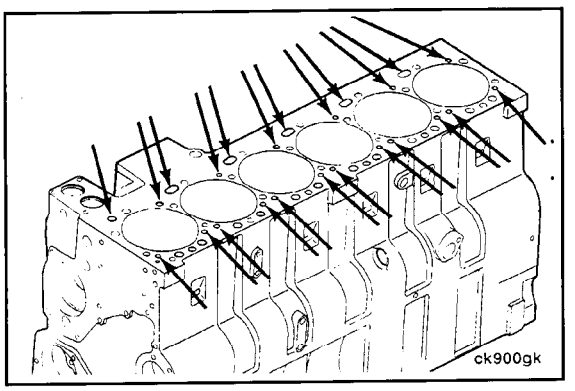
Build-up of deposits in the coolant passages can cause engine overheating.

NOTE: Excessive deposits may be cleaned in an acid tank, but the camshaft bushings and piston cooling nozzles must first be removed to prevent damage.



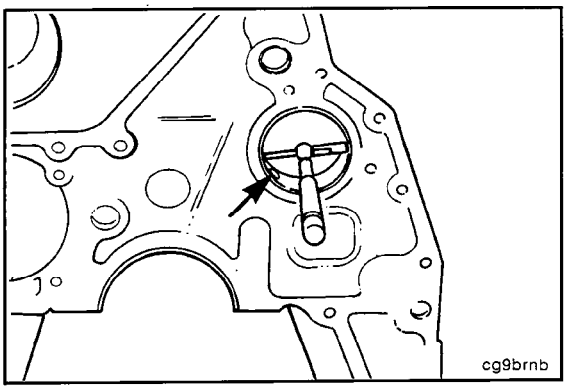
Warning: Use protective measures to prevent personal injury.

NOTE: The block may be cleaned in a hot tank using a soap and water solution without removing the camshaft bushings.



Measure the installed diameter of the camshaft bushings.

Camshaft Bushing Bore Diameter (Installed)		
mm		in
60.058	MIN	2.3645
60.112	MAX	2.367



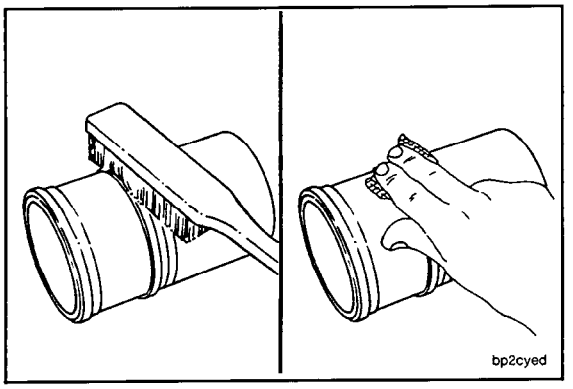
Cylinder Liners - Cleaning and Inspection for Reuse (1-12)

Cylinder Liners - Cleaning

Caution: To prevent cylinder liner damage, do not use a hone or any abrasives in the ring travel area of the liner. Abrasives can damage the surface finish and the cross hatch pattern, and can contaminate the cylinder liner.

Use a soft wire brush to clean the flange seating area.

Use a fine fibrous abrasive pad such as; Scotch Brite® 7448, Part No. 3823258, or equivalent to remove the remaining scale and rust.



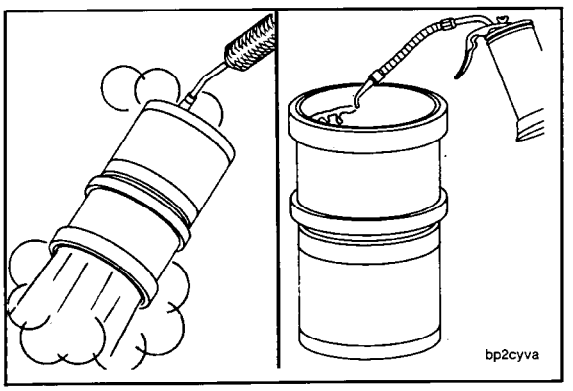
Warning: When using a steam cleaner, wear protective clothing and safety glasses or a face shield. Hot steam will cause serious personal injury.

Use a non-metallic bristle brush, detergent soap, and warm water to clean the inside diameter,

Use a steam cleaner or a solvent tank to clean the liners. Dry with compressed air.

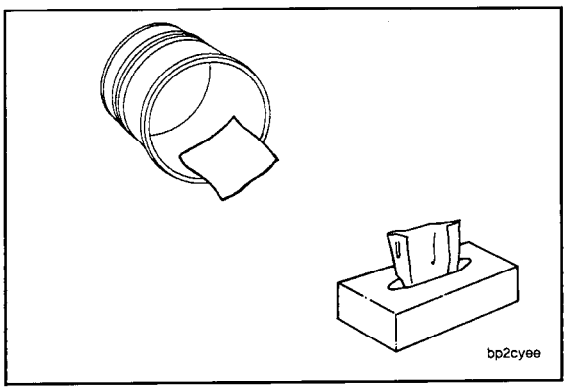
Use clean 15W-40 oil to lubricate the inside diameter of the liners.

Allow the oil to soak in the liner for five to ten minutes.



Use "lint-free" paper towels to wipe the oil from the inside of the liners.

Continue to lubricate the inside of the liners and wipe clean until the paper towel shows no gray or black residue.

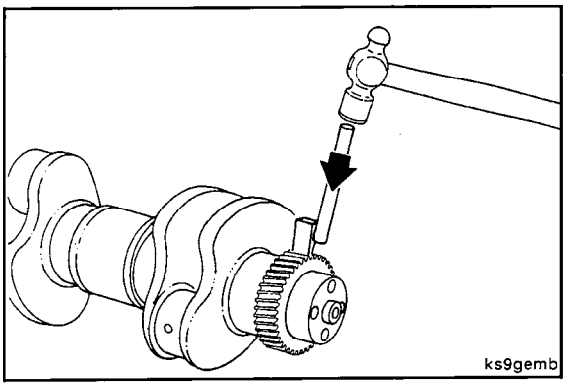


Place the point of the chisel between two gear teeth.

Strike the splitter with a two or three pound steel hammer.

Repeat this step if necessary.

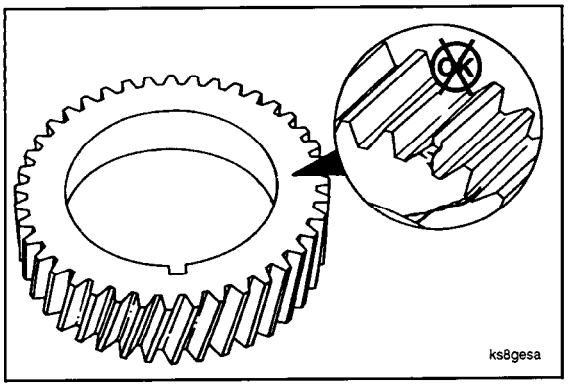
Use a dowel pin extractor to remove the gear alignment dowel pin.



Crankshaft Gear - Inspection

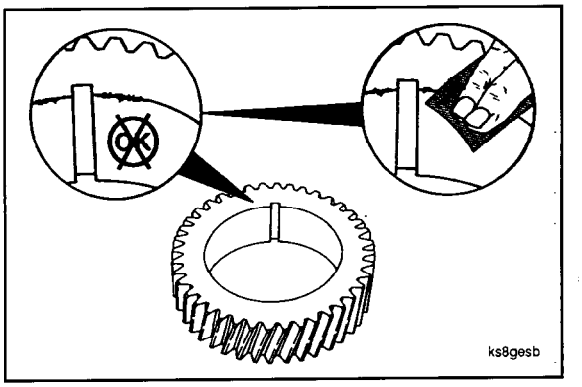
Visually inspect for cracks and broken or chipped teeth.

The gear **must** be replaced if it is damaged.



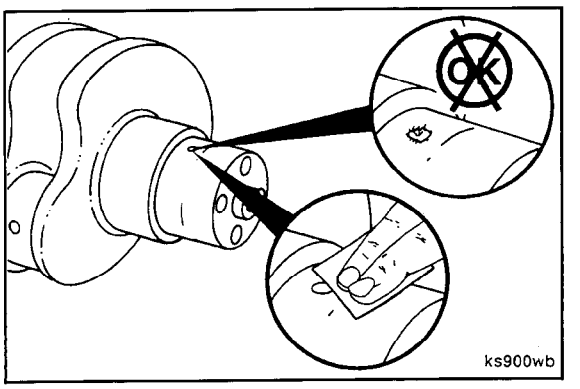
Visually inspect the gear and keyway for nicks or burrs.

Use fine crocus cloth to remove nicks and burrs.



Visually inspect the crankshaft gear journal and the gear alignment dowel pin hole for burrs or damage.

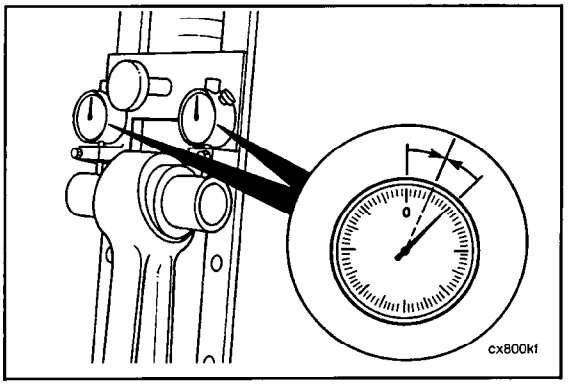
Use fine crocus cloth to remove burrs.



Check the dial indicators for the zero position again.

If the dial indicators show any change from zero, adjust the dials to half the indicated reading.

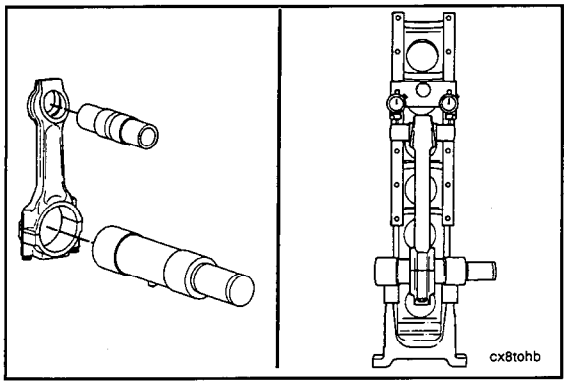
The fixture is now calibrated to allow the connecting rod to be installed into the fixture in either direction, and the dials will indicate an equal deflection on either side of zero.



Connecting Rod Alignment - Inspection

Install the mandrel and arbor into the connecting rod to be inspected.

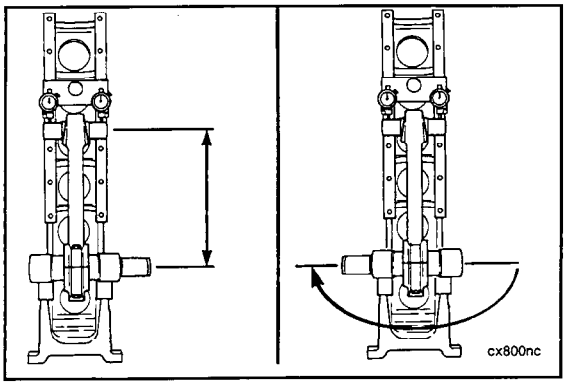
Install the connecting rod into the fixture.



Measure the connecting rod length and bend (alignment).

Connecting Rod Length		
mm		in
215.975	MIN	8.5029
216.025	MAX	8.5049

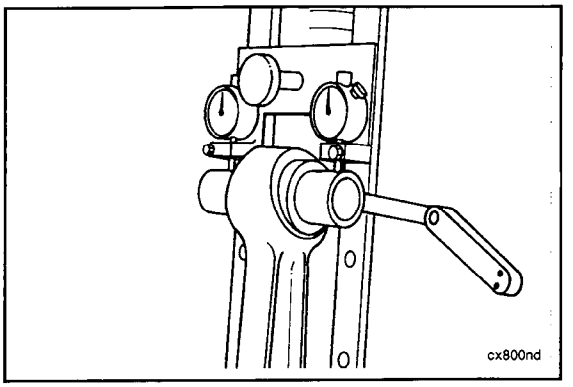
Connecting Rod Bend (Alignment)			
	mm		in
Bushing Removed	0.20	MAX	0.008
Bushing Installed	0.15	MAX	0.006



Connecting Rod Twist - Inspection

Install a feeler gauge between the mandrel and the dial indicator holding plate as shown.

Connecting Rod Twist			
	mm		in
Bushing Removed	0.50	MAX	0.020
Bushing Installed	0.30	MAX	0.012

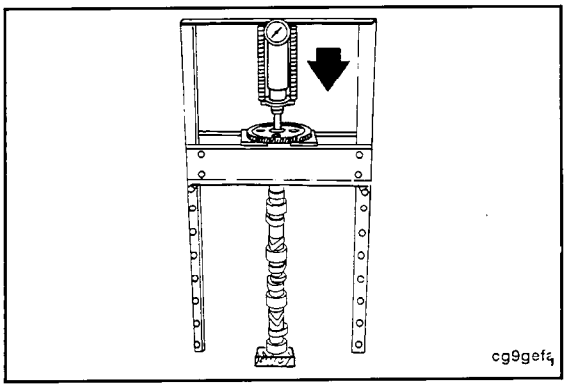


Camshaft Gear - Replacement (1-23)

Camshaft Gear - Removal

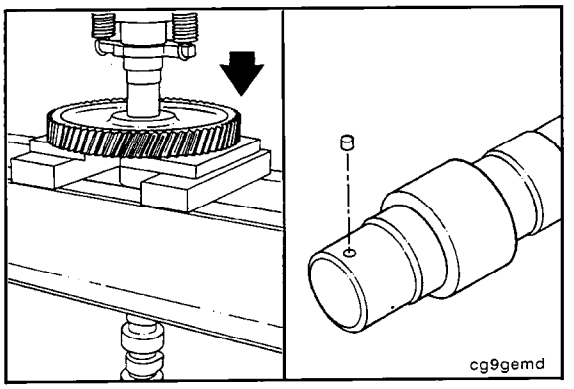
Caution: Place a wooden block under the camshaft to avoid damage as the camshaft drops free from the camshaft gear.

Place the camshaft and gear assembly in the hydraulic press.



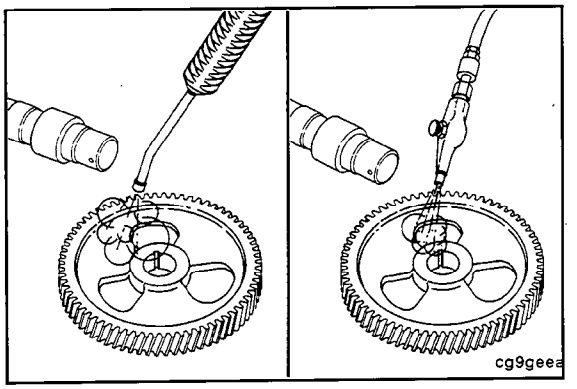
Push the camshaft from the gear.

Remove the camshaft dowel pin.



Camshaft Gear - Cleaning

Use solvent to clean the camshaft gear. Dry with compressed air.

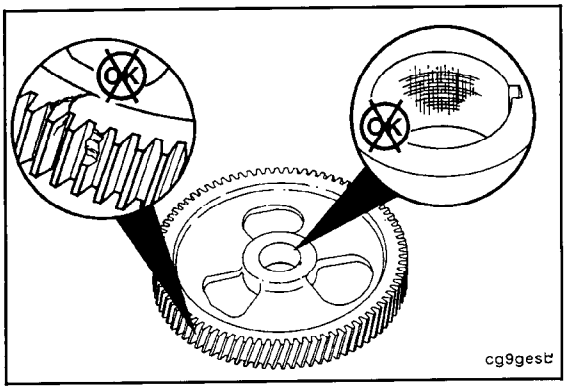


Camshaft Gear - Inspection

Visually inspect the camshaft gear for cracks, chipped, or broken teeth.

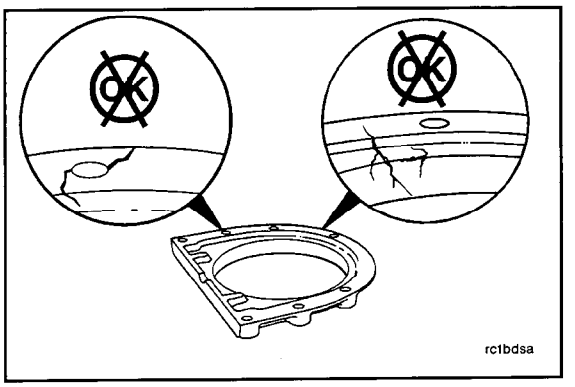
Inspect the bore of the gear for fretting or burrs.

NOTE: If the fretting, burrs, or raised material **cannot** be removed with Scotch-Brite® 7448, or equivalent, replace the gear.



Inspection

Inspect the rear cover for cracks or other damage.

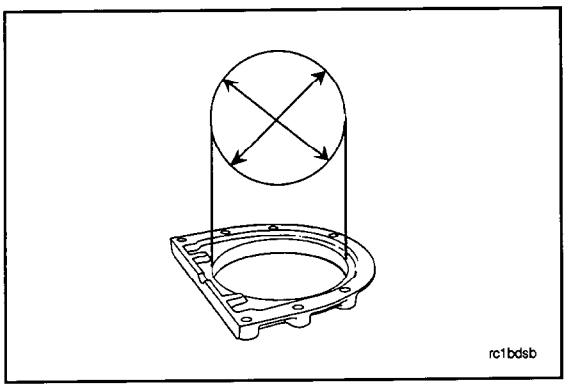


Measure the rear cover crankshaft seal bore.

The rear cover **must** be clamped to a flat surface for checking.

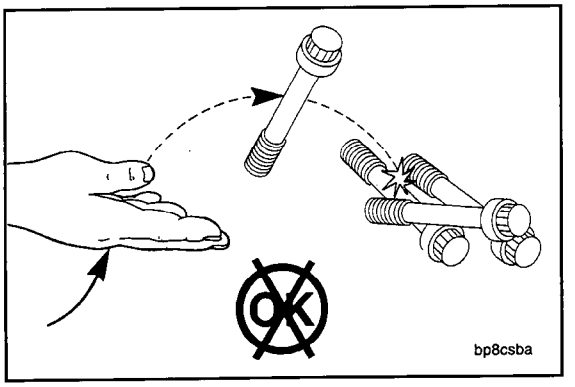
Rear Cover Crankshaft Seal Bore I.D.		
mm		**in**
149.96	MIN	5.904
150.04	MAX	5.907

Replace the rear cover if the crankshaft seal bore is **not** within specifications.



Cylinder Head Capscrews - Cleaning and Inspection for Reuse (1-29)

Caution: Prevent damage to the capscrews. Nicks in the body of the capscrew can cause an area of stress that can fail during engine operation. Damage to the threads will cause torque values to be incorrect and will damage the mating parts.

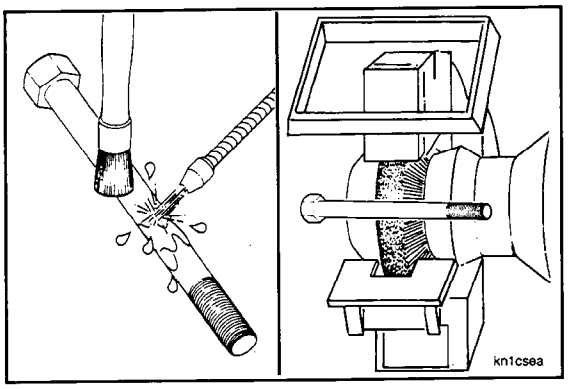


Cleaning

Caution: Do not use caustic or acid solutions to clean the cylinder head capscrews.

Use a petroleum-based solvent to clean the capscrews. Dry with compressed air.

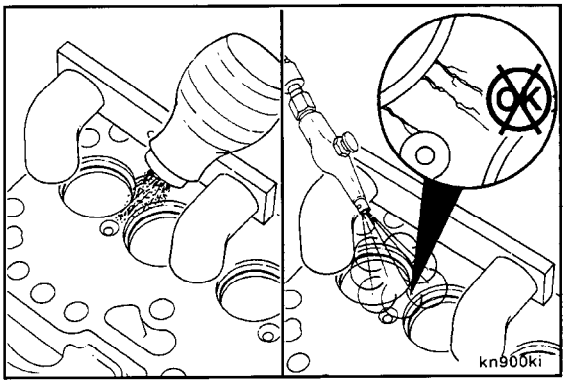
Clean the capscrews thoroughly with a wire brush, a wire wheel (soft), or use a non-abrasive bead blast to remove deposits from the body and threads.



Ref. No	Part Name	Qty.
1	Head, Cylinder	1
2	Plug, Expansion	1
3	Plug, Expansion	5
3	Plug, Expansion	1
4	Plug, Expansion	2
5	Guide, Valve Stem	12
6	Insert, Valve Seat (Exh)	6
7	Insert, Valve Seat (Int)	6
8	Plug, Pipe	1
9	Plug, Pipe	1
10	Plug, Pipe	1
11	Seal, Valve Stem (Int)	6
12	Valve, Intake	6
13	Collet, Valve	24
14	Valve, Exhaust	6
15	Washer, Sealing	2
16	Plug, Pipe	2
17	Spring, Valve (Int)	6
18	Spring, Valve (Exh)	6
19	Retainer, Valve Spring	12
20	Seal, Valve Stem (Exh)	6
21	Plug, Expansion	1
22	Coupling, Elbow	1
23	Gasket, Cylinder Head	1
24	Screw, Hex Hd Cap (Flange)	12
25	Screw, Hex Hd. Cap (Flange)	14

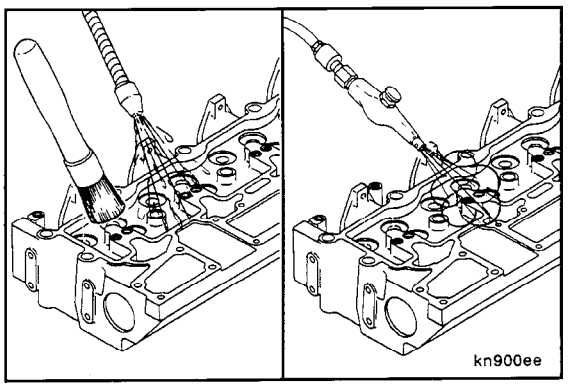
Place the magnetizing head on the combustion surface as shown to check for cracks that run lengthwise of the cylinder head.

Repeat the procedure as outlined above.



Remove all magnetism and use solvent to clean the cylinder head. Dry with compressed air.

NOTE: The cylinder head **must** be thoroughly cleaned after using the magnetic crack detector to remove all of the metal powder.

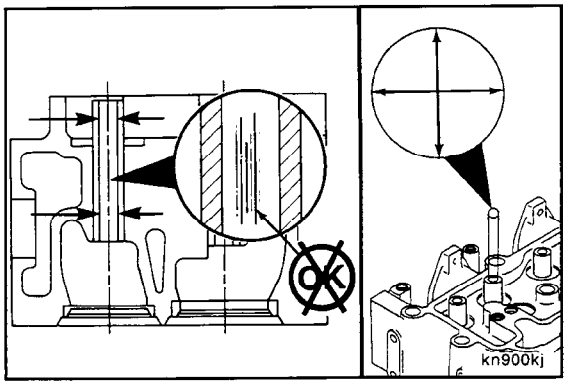


Valve Guide - Inspection

Visually inspect the valve guides for scuffing or scoring.

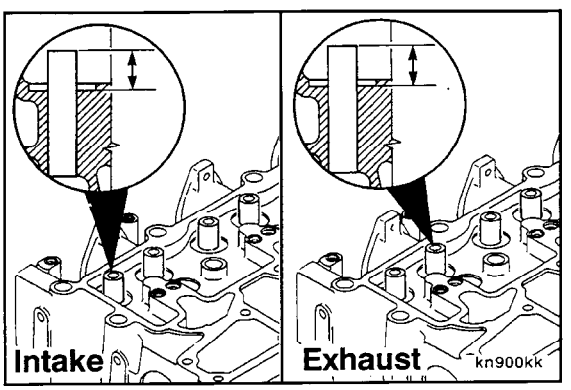
Use a small bore gauge to measure the inside diameter of the valve guides in locations 13 mm [1/2 inch] from each end and at the center as shown.

Valve Guide I.D. (Installed) (Used)		
mm		**in**
9.539	MIN	0.3756
9.591	MAX	0.3776



Use a depth micrometer to measure the valve guide installed height. Measure from the top of the valve guide to the bottom of the recess area.

Valve Guide Height (Installed)			
	mm		**in**
Intake	20.65	MIN	0.813
	21.16	MAX	0.833
Exhaust	22.50	MIN	0.886
	23.01	MAX	0.906



If damage is found or the valve guide(s) do **not** meet the limits specified, the valve guide(s) **must** be replaced. Refer to Procedure 2-03.

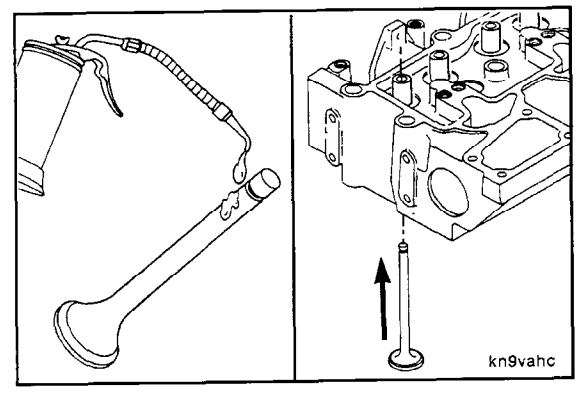
Use SAE 90W engine oil to lubricate the valve guide bores and valve stems.

Install the valves in the valve guides. The exhaust valves have smaller diameter heads.

NOTE: If any valves are being used again, the valves must be installed in the same location as they were removed.

NOTE: The valves should drop into the valve guides with little or no resistance.

After the valves are installed, place the cylinder head on a flat surface that will **not** damage the cylinder head surface.

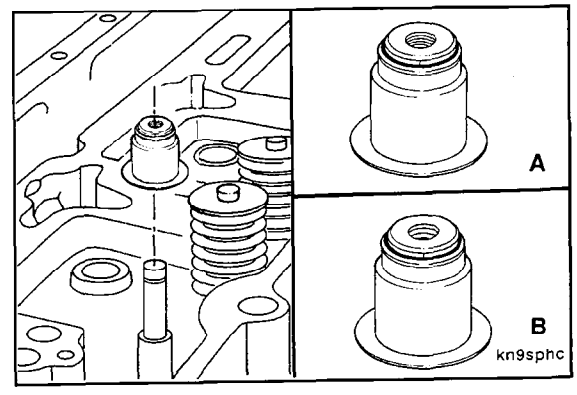


Install the valve spring seat/valve seal assembly over the valve stem.

NOTE: To prevent oil carryover, the seals are color coded and must be installed as follows:

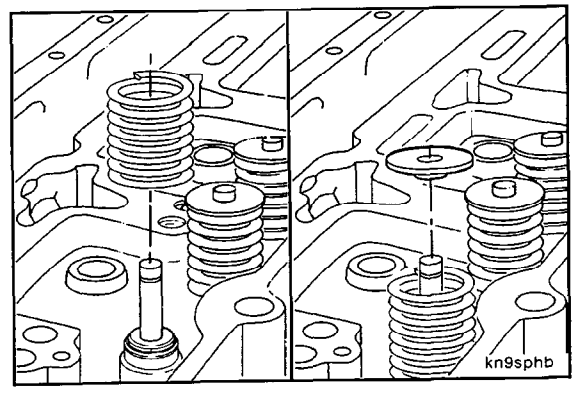
Exhaust Valve (A): Orange (with 64 grooves per inch)

Intake Valve (B): Black (with 40 grooves per inch)



Install the valve springs.

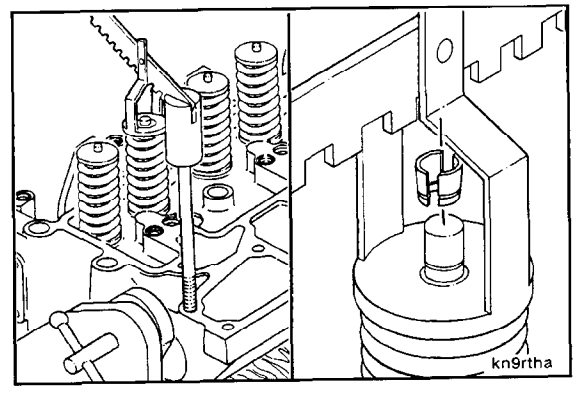
Install the valve spring retainers.



Use valve spring compressor, Part No. ST-448, or its equivalent (refer to the Service Tools list) to compress the valve springs.

Install the new valve spring retainer collets.

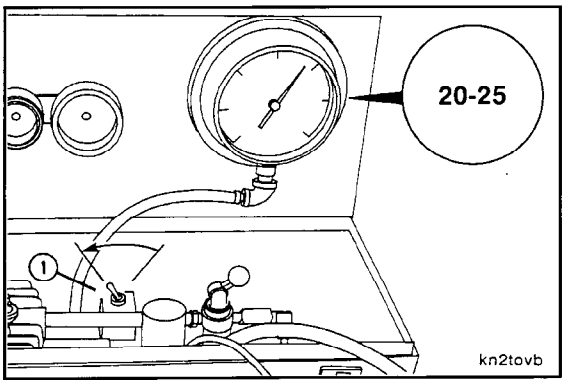
NOTE: Use new valve spring retainer collets when rebuilding the cylinder head.



Operate the vacuum pump until the gauge indicates the specified vacuum.

Valve to Valve Seat Vacuum			
	mm Hg		in Hg
New	508	MIN	20
	635	MAX	25
Used	457	MIN	18

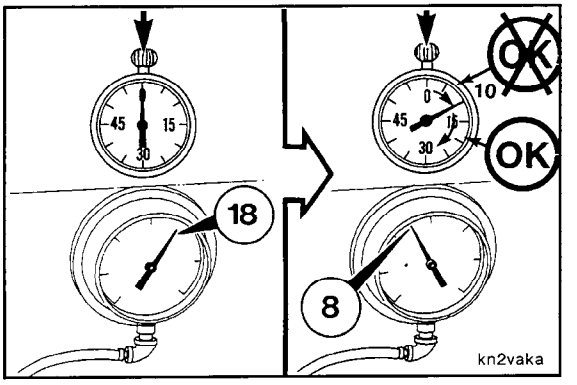
Turn the toggle switch (1) to the "OFF" position.



Use a stopwatch and start timing when the needle on the gauge indicates 457 mm Hg [18 in. Hg].

Stop timing when the needle on the gauge indicates 203 mm Hg [8 in. Hg].

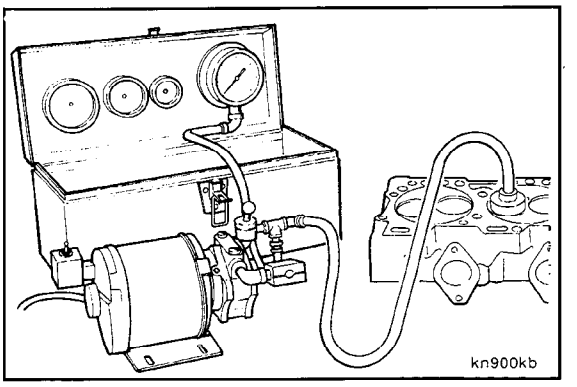
The elapsed time for the needle to move between the specified gauge readings **must** be 10 seconds or more.



If the elapsed times is **less** than 10 seconds, perform the following checks:

- Repeat the test to be sure the equipment is operating properly.
- Use a mallet to hit the valve stem lightly to make sure the valve is seated. Repeat the test.
- Apply a thin layer of grease on the outside diameters of the insert and the valve head. Repeat the test. The grease pattern will show the point of leakage.

A break in the grease seal pattern will indicate leakage between the valves and valve seat or the valve seat insert and the cylinder head. Refer to Cylinder Head - Rebuild.



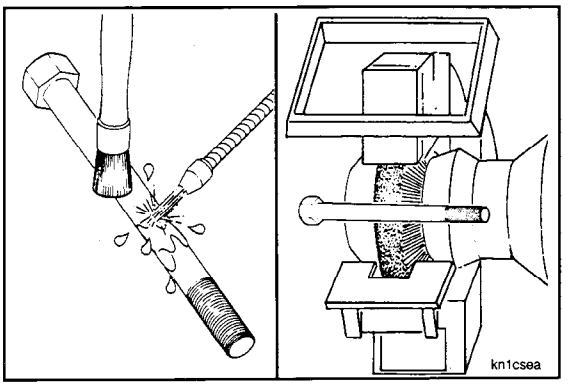
Cylinder Head Capscrew - Cleaning and Inspection (2-07)

Cleaning

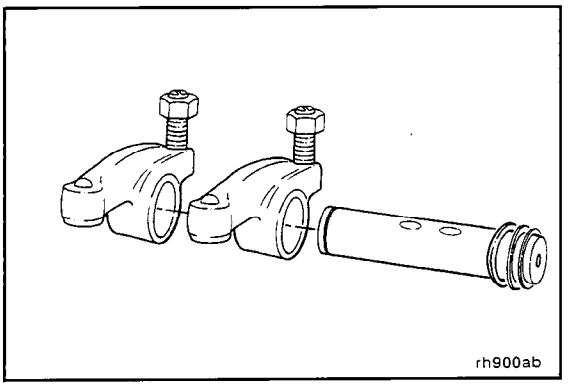
Caution: Do not use caustic or acid solutions to clean the cylinder head capscrews.

Use a petroleum-based solvent to clean the capscrews.

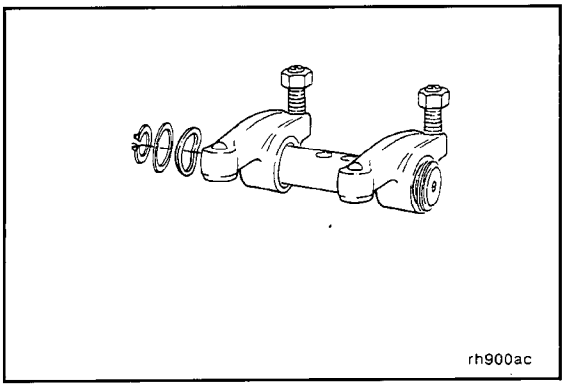
Clean the capscrews thoroughly with a wire brush, a soft wire wheel, or use a non-abrasive bead blast to remove deposits from the shank and the threads.



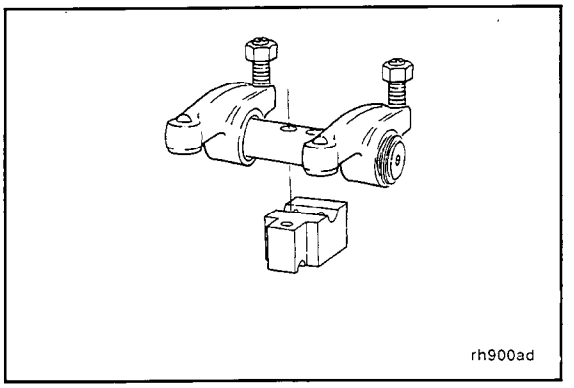
Position the levers on the rocker shaft.



Install the remaining wavey spring washer, thrust washer and retaining ring as illustrated.



Compress the wavey spring washers and install the bottom half of the pedestal as illustrated.



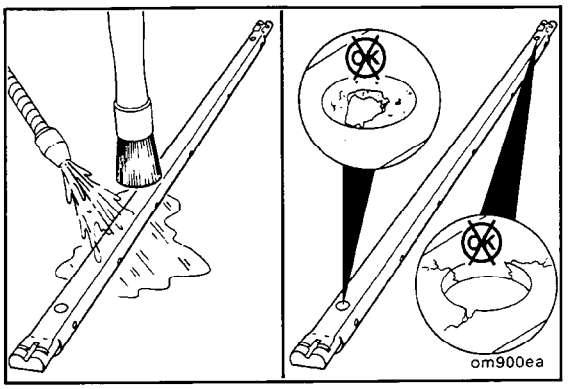
Rocker Assembly Oil Manifold - Cleaning and Inspection for Reuse (3-02)

Cleaning

Use solvent to clean the oil manifold. Dry with compressed air.

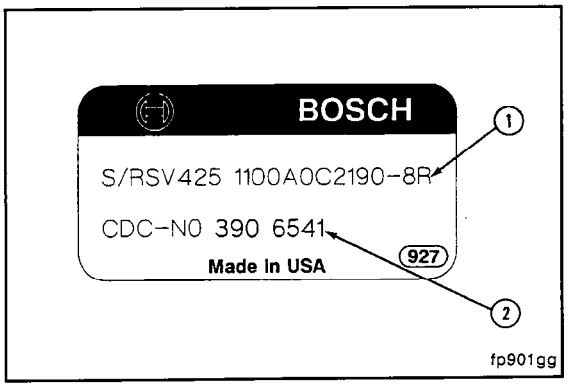
Inspection

Visually inspect the oil manifold for cracks, plugged oil holes, or other damage. If the oil manifold is cracked or damaged, it must be replaced.



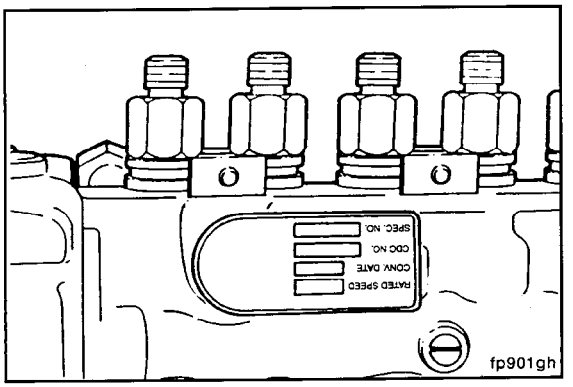
Governor - Data Tag Information

1. Bosch Designation Code
2. Vendor Fuel Injection Pump Part Number



Derivative Fuel Injection Pump - Data Tag Information

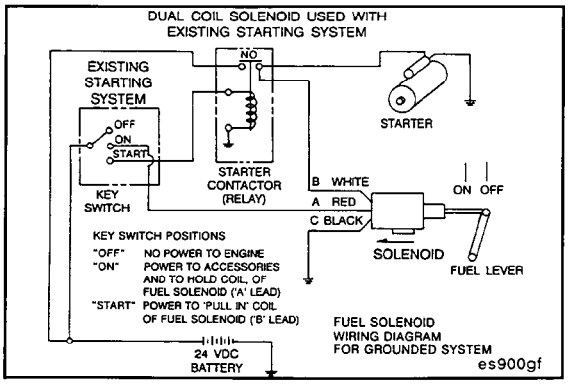
This tag is installed on the fuel injection pump when a base fuel injection pump is converted to a derivative fuel injection pump.



Fuel Shutoff Solenoid - Wiring Requirements

The solenoid **must** be wired properly. Refer to the chart below to find the correct gauge size and length of continuous wire for the white (pull-in) wire, which connects the solenoid wiring. The black (ground) wire **must** be the same gauge as the white (pull-in) wire regardless of its length.

	Length of Wires		
	0-4.5 ft	0-7.0 ft	0-11 ft
gauge	14	12	10



14 gauge wire is required for the red (hold-in) wire, which connects to the "RUN" terminal on the ignition switch.

Wire Gauge Size*		
mm		in
1.5	14	0.060
1.9	12	0.076
2.4	10	0.096

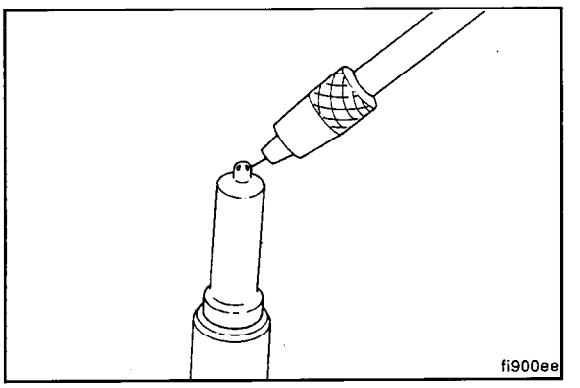
* Diameter of conductor only. Does **not** include insulation.

Injectors and Fuel Lines - Group 06

Section Contents

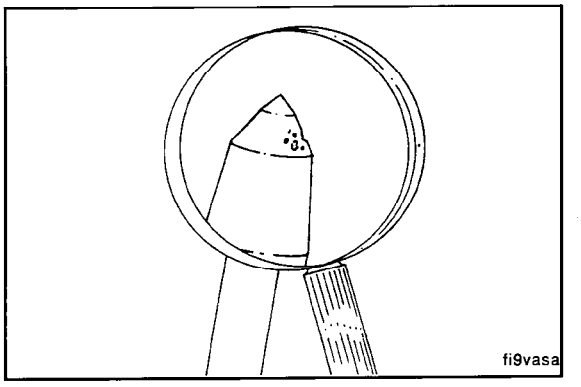
Clean the spray holes as shown with the appropriate size cleaning needle.

Remove burned-on combustion deposits on all nozzles with a commercially available cleaner. Rinse all parts in clean test oil.

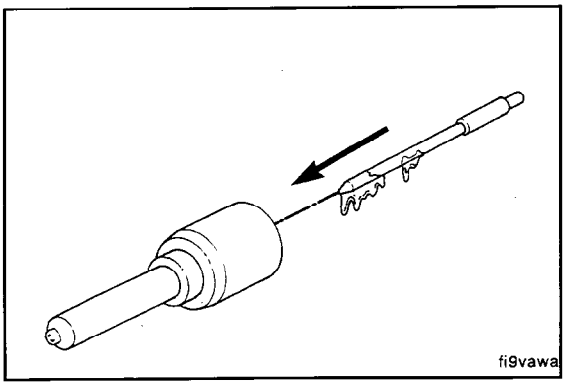


Clean the needle valve tip with a brass brush. Inspect for rough surfaces or erosion. The pressure shoulder will normally have a rough machined appearance.

NOTE: Deteriorated needle valves **must** be replaced as a matched unit with their compatible nozzle body.



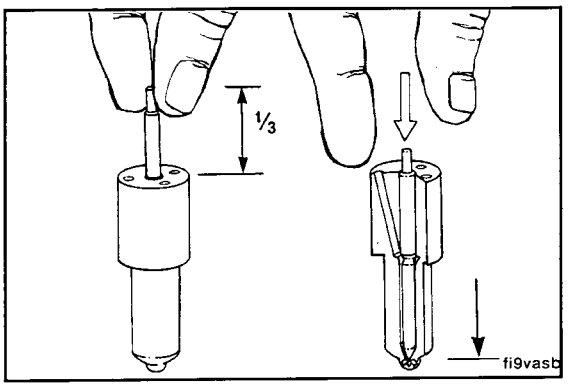
Dip the needle valve in clean test oil and insert the needle valve all the way into the nozzle body.



Pull the needle valve one-third of the way out of the nozzle body. With the needle valve in the vertical position, the needle valve **must** slide all the way back into the nozzle body under its own weight.

If the nozzle fails the slide test, clean and test the nozzle again.

NOTE: Any needle valve and nozzle body assembly which does not pass this test must be replaced.



Lubricating Oil System - General Information

The lubricating oil system group consists of the oil pan, oil suction tube, oil dipstick and tube, oil filter head, oil cooler element, oil temperature thermostat, oil pressure regulator and the lubricating oil pump.

Instructions for pressure testing the lubricating oil cooler element are included in this section. The oil cooler does **not** have a replaceable element and **cannot** be rebuilt in the field.

Lubricating Oil Cooler and Filter Head

The oil cooler cover and filter head are combined into one casting. The oil pressure regulator, oil temperature thermostat and filter bypass valve are also located in this housing.

Oil Pressure Regulator

A pressure regulator valve is used to provide pressure relief during cold starting and to regulate oil pressure after the oil is warm.

Oil Filter Head

The oil filter head is an integral part of the oil cooler housing cover and includes a filter bypass valve. The filter bypass valve is designed to maintain oil flow to the engine if the oil filter becomes plugged.

Oil Temperature Thermostat

An oil temperature thermostat is located in the top of the oil cooler housing. The thermostat modulates oil flow at temperatures between 100° and 115°C [212° and 239°F] and full flow through the oil cooler at oil temperatures above 115°C [239°F]. The thermostat also incorporates a pressure relief feature which allows oil to bypass the cooler should it ever become plugged.

Lubricating Oil Pump

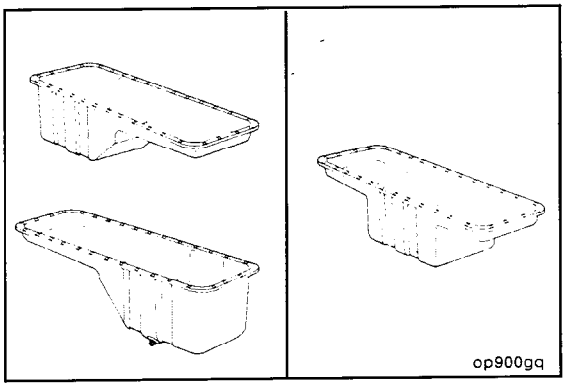
It is **not** practical to rebuild the gerotor type lubricating oil pump. It can be reused if it meets the inspection criteria.

Dipstick

A center-mounted dipstick location is used on either side of the cylinder block for all oil pans. Service replacement oil dipsticks do **not** have the high and low oil level marks indicated on the dipstick. The dipstick **must** be calibrated after the engine is installed in the chassis.

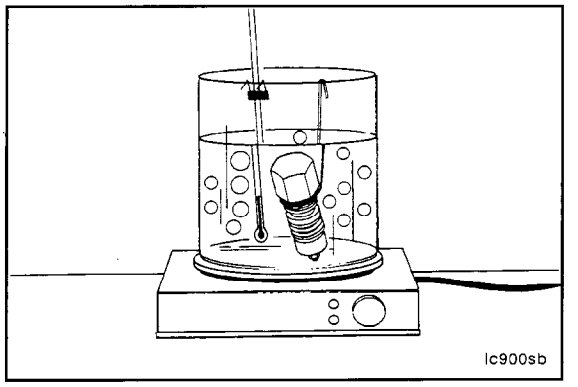
Oil Pan

There are two oil pan options available. One oil pan provides a center sump arrangement. The other oil pan can be used to provide either a front or a rear sump with the use of the corresponding internal oil suction tube. Both oil pans have the same capacity.



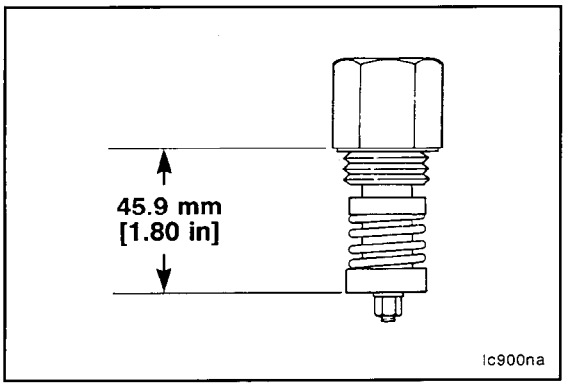
Suspend the thermostat and a 116°C [240°F] thermometer in a container of new lubricating oil. Do **not** allow the thermostat or the thermometer to touch the side or bottom of the container.

Heat the lubricating oil.



NOTE: Write down the temperature at which the thermostat is fully extended. The thermostat **must** be fully extended to at least 45.9 mm [1.80 inch] when the temperature reaches 116°C [240°F].

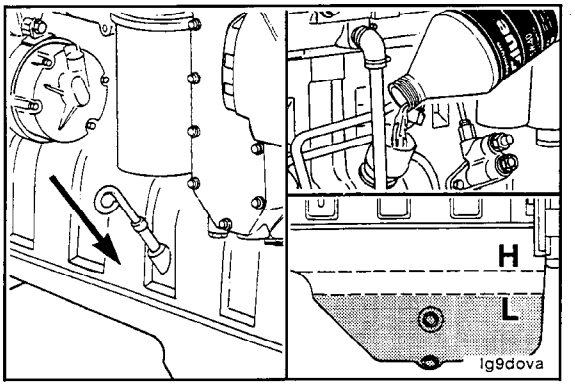
Replace the thermostat if it does **not** operate as described.



Lubricating Oil Dipstick - Calibration (7-07)

Install the dipstick in the dipstick tube housing.

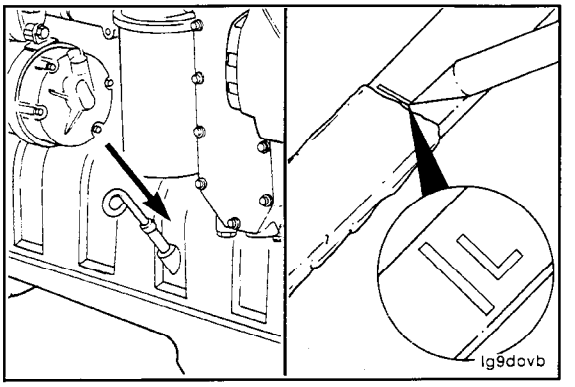
Use clean 15W-40 engine oil to fill the oil pan to the specified "low" oil level. Refer to Lubricating Oil System Specifications for engine oil capacity.



Caution: The dipstick will break if the scribe mark is too deep.

Remove the dipstick and scribe a mark across the dipstick and mark the "low" oil level with an "L".

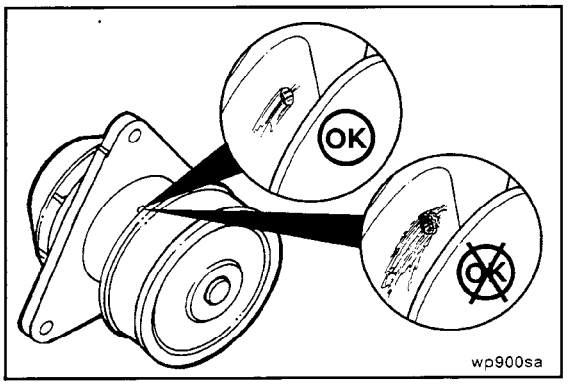
NOTE: If a new blank dipstick is being used, cut the dipstick off approximately 38 mm [1.5 inches] below the "low" oil level mark.



Water Pump Assembly - Cleaning and Inspection for Reuse (8-01)

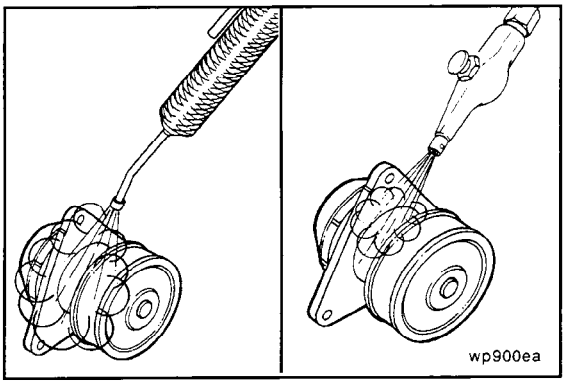
Cleaning

The water pump seal design requires a coolant film for lubrication and cooling. Therefore, it is normal to observe a minor chemical buildup or streaking at the weep hole. Before cleaning the water pump, inspect the weep hole for large amounts of chemical buildup. Replace the pump if large amounts of chemical buildup is observed.



Warning: When using a steam cleaner, wear protective clothing and safety glasses or a face shield. Hot steam will cause serious personal injury.

Use solvent or steam to clean the water pump exterior. Dry with compressed air.

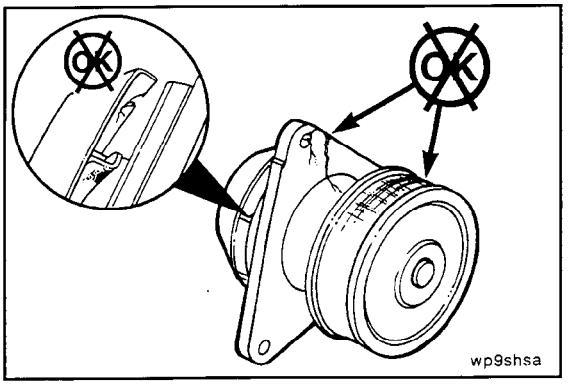


Inspection

Visually inspect the water pump body for cracks or damage.

Visually inspect the impeller for cracks, erosion, or damage.

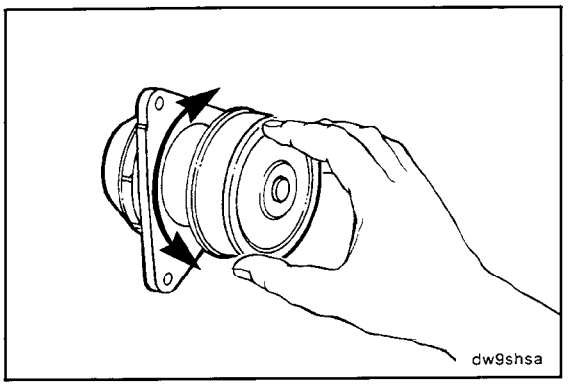
Visually inspect the pulley for damage or wear.



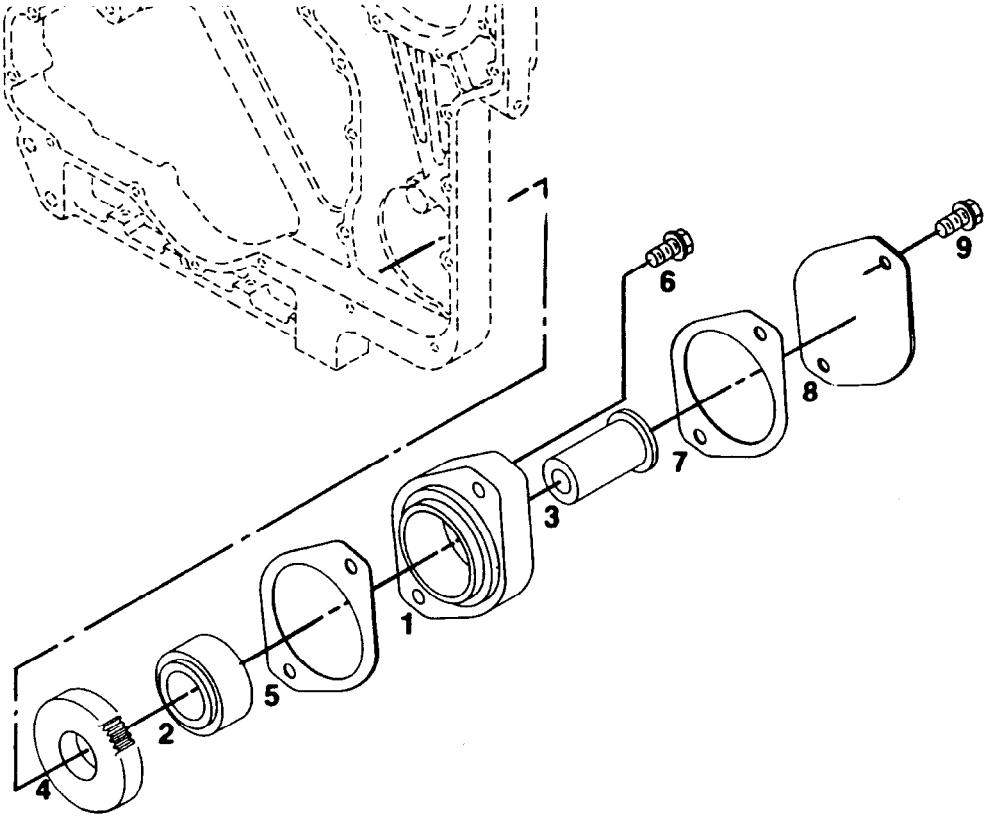
Rotate the water pump shaft by hand to inspect the bearings and the impeller for freedom of rotation.

NOTE: If damaged parts are found or the shaft does **not** rotate freely in the water pump body, the water pump **must** be replaced.

NOTE: Parts replacement is **not** practical: the water pump is serviced as an assembly.

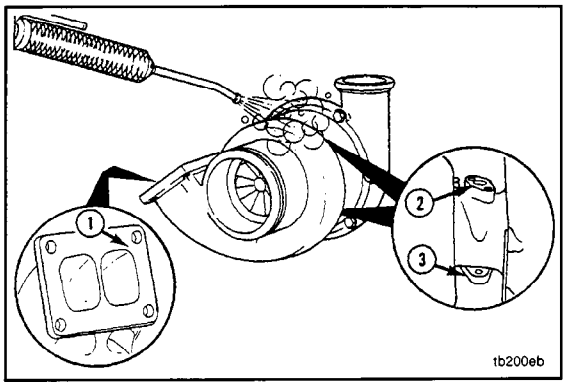


Accessory Drive Adapter - Exploded View



Ref. No.	Part Name	Qty.
1	Adapter, Accessory Drive	1
2	Bearing	1
3	Shaft, Accessory Drive	1
4	Gear, Accessory Drive	1
5	Gasket, PTO Drive Cover	1
6	Screw, Hex Head Cap	2
7	Gasket, PTO Drive Cover	1
8	Plate, PTO Drive Cover	1
9	Screw, Hex Head Cap	2

Turbocharger - Cleaning and Inspection for Reuse (10-01)



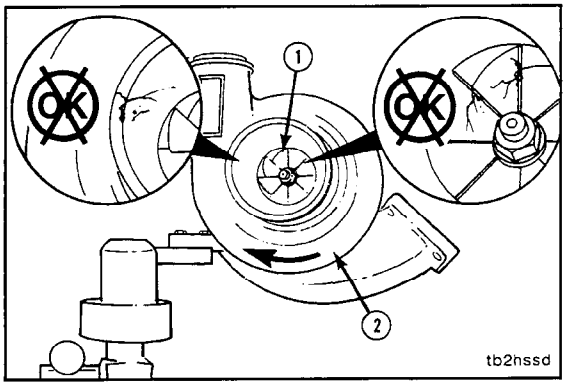
Remove all carbon deposits and gasket material from surfaces (1), (2) and (3).

Warning: When using a steam cleaner, wear protective clothing and safety glasses or a face shield. Hot steam will cause serious personal injury.

Caution: Tape or plug all openings to prevent solvent or steam from damaging the oil cavities in the turbocharger.

Use solvent or steam to clean the exterior of the turbocharger. Dry with compressed air.

Inspection



Visually inspect the housings for damage.

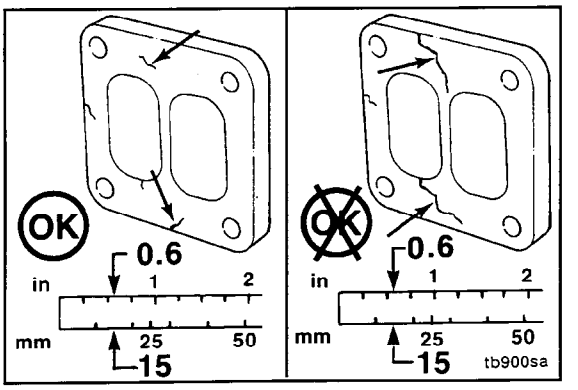
Visually inspect the turbine wheel and compressor impeller (1) for fretting, cracked or broken vanes.

Turn the impeller in the direction shown with arrow (2), to inspect the turbine shaft for freedom of rotation. The shaft **must** rotate freely.

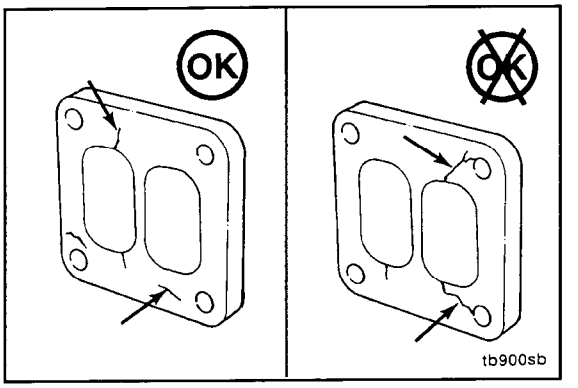
Replace damaged parts.

Visually inspect the mounting flange.

Cracks on the mounting flange longer than 15 mm [0.6 inch] are **not** acceptable.



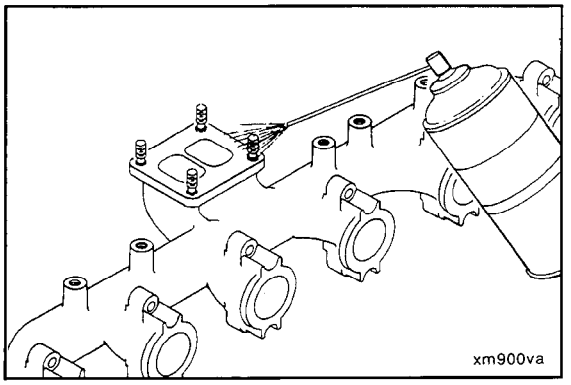
Cracks **must** not reach the mounting holes.



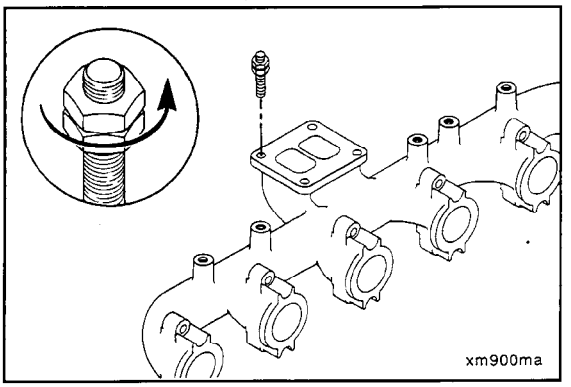
Exhaust Manifold Turbocharger Mounting Stud - Replacement (11-02)

Removal

Apply penetrating oil to the base of the turbocharger mounting stud to be removed. Follow the manufacturer's instructions.



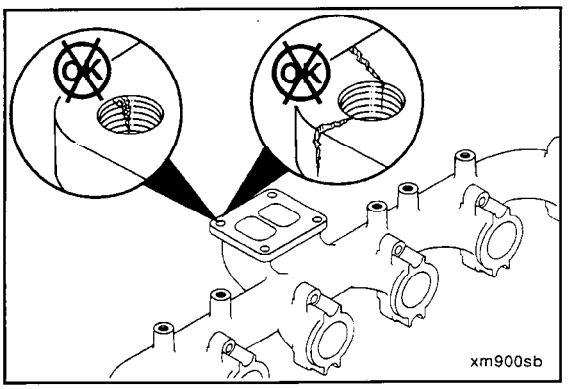
Use a standard stud extractor or two nuts locked together to remove the turbocharger mounting stud(s) from the manifold.



Inspection

Visually inspect for damaged threads in the turbocharger mounting stud holes.

Visually inspect the manifold for cracks or damage.



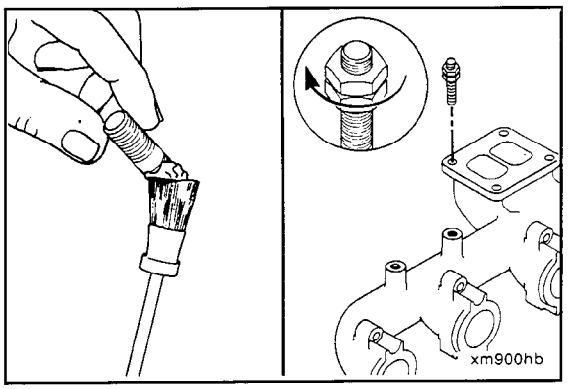
Installation

Use precoated turbocharger mounting studs or apply a thin coating of nickel based, high temperature, anti-seize compound to the coarse threads of the stud.

Install the studs in the mounting flange.

Use two mounting nuts locked together to tighten the studs.

Torque Value: 10 N•m [89 in-lb]



Engine Testing - General Information

This section outlines engine testing and engine run-in recommendations for 614 Series engines. All engines **must** be run-in after a rebuild or a repair involving the replacement of one or more piston ring sets, cylinder liners or cylinder kits.

Caution: Incorrect or insufficient break-in of the piston rings will lead to early oil consumption or high blowby complaints. Adherence to these run-in guidelines will allow the full durability of new rings to be realized.

The engine test is a combination of an engine run-in and a performance check. The engine run-in procedure provides an operating period that allows the engine parts to achieve a final finish and fit. The performance check provides an opportunity to perform final adjustments needed to optimize the engine performance.

An engine test can be performed by using either an engine dynamometer or a chassis dynamometer. If a dynamometer is **not** available, an engine test **must** be performed in a manner that simulates a dynamometer test.

Check the dynamometer before beginning the test. The dynamometer **must** have the capability to test the performance of the engine when the engine is operating at the maximum RPM and horsepower range (full power).

Before running the engine, make sure the engine is filled with the proper coolant and the lubricating oil system is filled and primed.

The engine crankcase pressure, often referred to as engine blowby, is an important factor that indicates when the piston rings have achieved the correct finish and fit. Rapid changes of blowby or values that exceed specification more than 50 percent indicate that something is wrong. The engine test **must** be discontinued until the cause has been determined and corrected.

In-Chassis Run-In

The majority of heavy duty diesel applications will provide sufficient run-in under normal **loaded** operations. However, light load/high speed operation **must** be avoided during the run-in period. The following in-chassis run-in guidelines are recommended for 614 Series engines after a repair involving replacement of one or more of the piston ring sets, cylinder liners, or cylinder kits where engine or chassis dynamometer or load bank run-in **cannot** be performed.

SRT 14-704, Engine - Run-in and Test (in-Chassis), provides time for in-chassis run-in when there is no other way to perform the run-in (chassis dynamometer, load bank or portable dynamometer) and the engine will be applied in a high speed or low load operation immediately after the engine is returned to service.

Engine Dynamometer Run-in

This is the preferred method of run-in for engines that have been rebuilt **out-of-chassis.** It is **not** practical, nor recommended, that an engine be removed from the application to conduct the run-in after a rebuild or cylinder repair has been performed in-chassis. SRT 14-701, Engine - Run-In and Test (Engine Dynamometer) provides the time for this work. There is no requirement, nor is it recommended for an engine that has been run-in and tested on an engine dynamometer to be run-in again after it has been reinstalled in the vehicle or equipment.

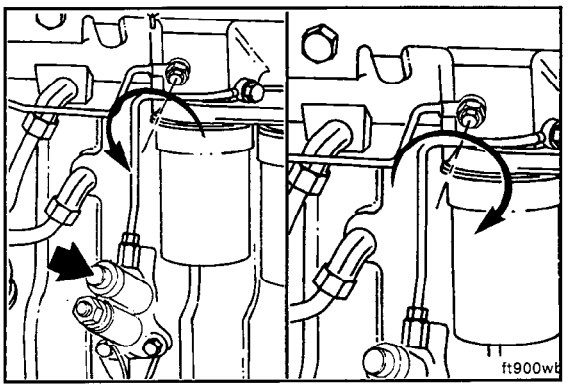
8 mm

NOTE: Manual venting is required if the fuel filter is not properly filled prior to installation.

Open the vent screw.

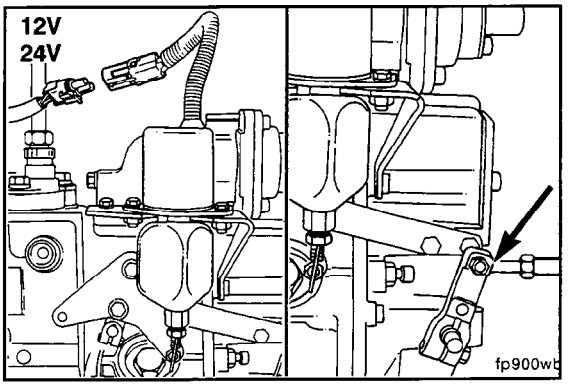
Operate the plunger on the fuel transfer pump until the fuel flowing from the fitting is free of air.

Tighten the vent screw.



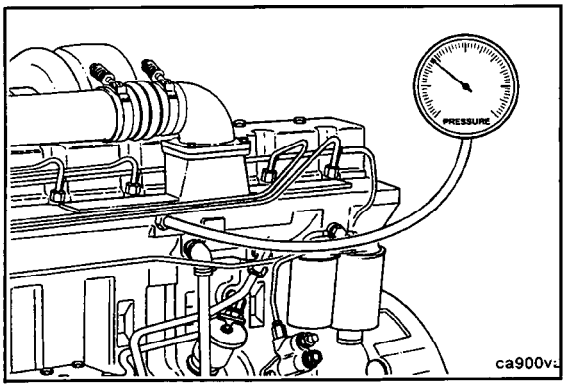
Check the voltage rating on the fuel pump solenoid before connecting the electrical wires to it. Make sure the voltage supply matches that of the fuel pump solenoid.

Attach the throttle control rod onto the fuel pump throttle lever.



To determine the amount of turbocharger boost, remove the 1/4 inch pipe plug in the cylinder head and install the intake manifold pressure sensor or pressure gauge, Part No. ST-1273.

Minimum Gauge Capacity: 1905 mm Hg [75 in. Hg]

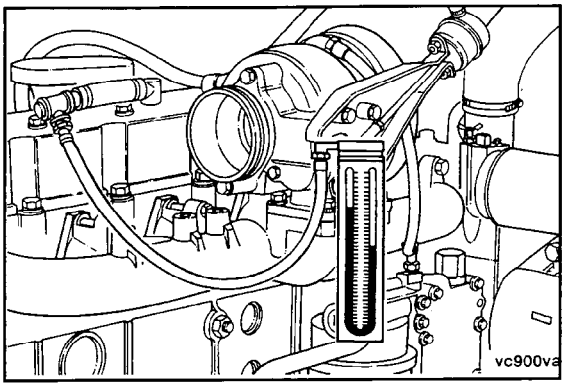


Checking Tool, Part No. 3822566

For accurate engine crankcase blowby measurement, insert blowby checking tool, Part No. 3822566, in the crankcase breather vent.

Connect a water manometer to the blowby tool. A pressure gauge can be used in place of the manometer.

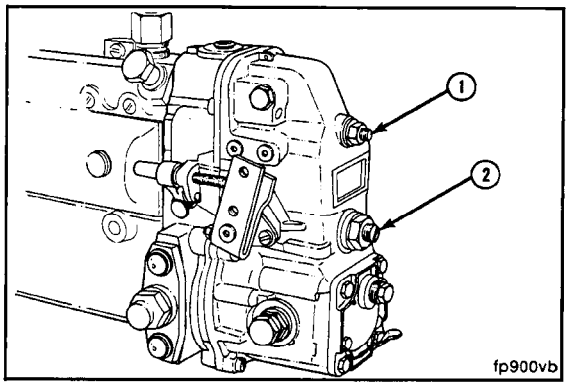
Minimum Gauge Capacity: 1270 mm H_20 [50 in. H_20]



Fuel Injection Pump - Idle Speed Adjustment (14-06)

RSV Governor

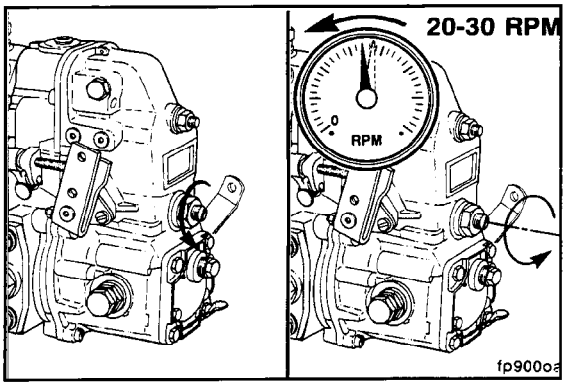
Idle adjustment for industrial engines requires the setting of both the low idle screw (1) and the bumper spring screw (2) on the fuel injection pump.



19 mm, Screwdriver, Tachometer

First, loosen the locknut and back out the bumper spring screw on the fuel injection pump until there is no change in engine speed.

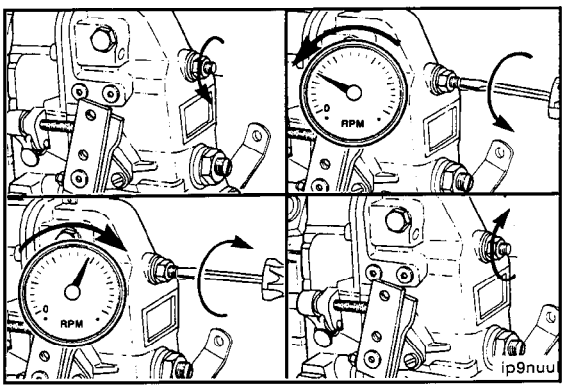
The speed should drop 20-30 RPM as the bumper spring screw is backed out.



13 mm, Screwdriver, Tachometer

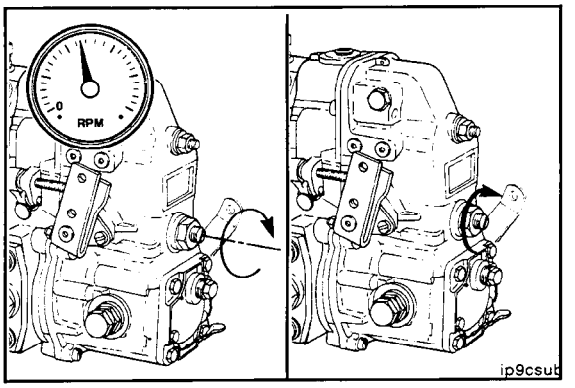
Loosen the locknut and adjust the low idle screw to 20-30 RPM less than the desired speed. Turn the low idle screw **counterclockwise** to decrease RPM; **clockwise** to increase RPM. Tighten the low idle screw locknut.

Torque Value: 8 N•m [72 in-lb]

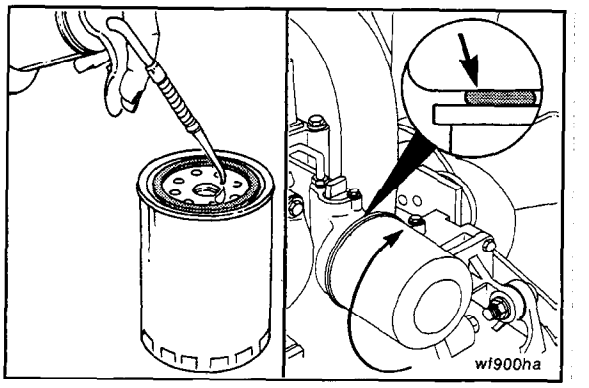


Turn the bumper spring screw **clockwise** until the desired idle speed is obtained. Tighten the bumper spring screw locknut.

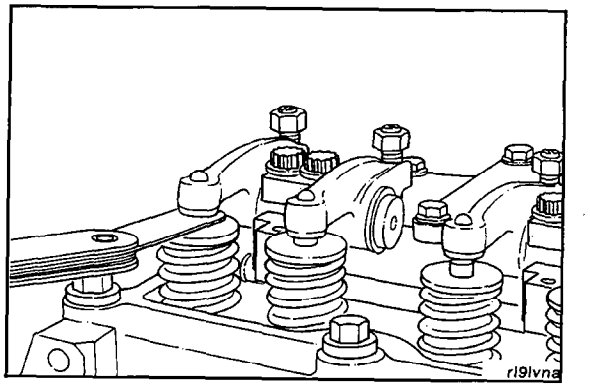
Torque Value: 8 N•m [72 in-lb]



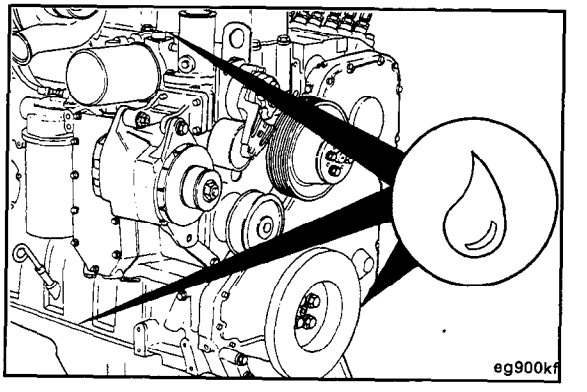
Install a new coolant filter. Fill the cooling system with a mixture of 50% water and 50% ethylene-glycol type antifreeze.



Adjust the valve clearance. Refer to Engine Assembly (00-02).



Tighten all capscrews, plugs and fittings as necessary. Refer to the *Specifications section.*

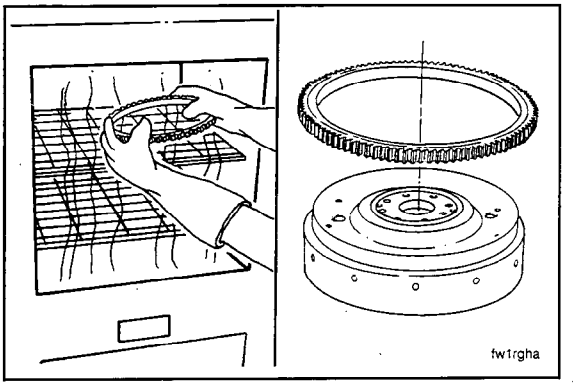


Caution: Wear protective gloves to prevent personal injury when handling parts that have been heated.

NOTE: The gear **must** be installed so the bevel on the teeth is toward the crankshaft side of the flywheel.

Remove the gear from the oven, and install it on the flywheel before it cools. Allow the air to cool the gear. Do **not** use water or oil to reduce the cooling time.

NOTE: If an oven is **not** available, use a heating torch to heat the inside diameter of the new ring gear to 177°C [350°F]. Use a Tempilstik® crayon or its equivalent to check the gear temperature before installing it on the flywheel.

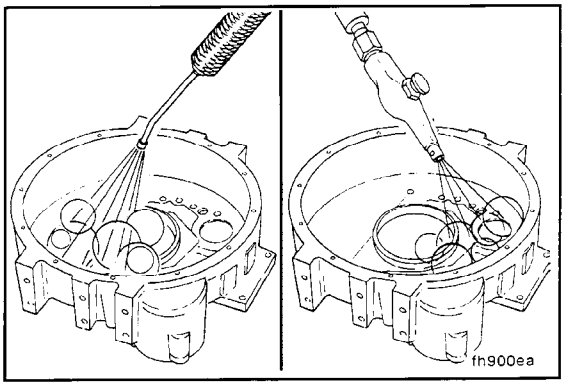


Flywheel Housing - Cleaning and Inspection for Reuse (16-04)

Cleaning

Warning: When using a steam cleaner, wear protective clothing and safety glasses or a face shield. Hot steam will cause serious personal injury.

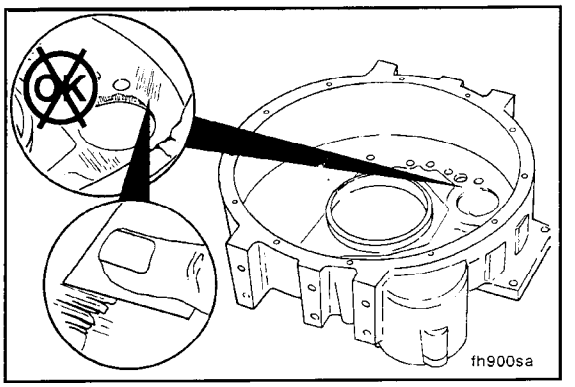
Use steam or solvent to clean the flywheel housing. Dry with compressed air.



Inspection

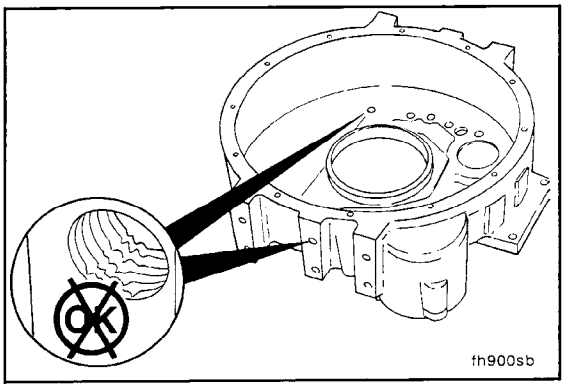
Visually inspect all surfaces for nicks, burrs, or cracks.

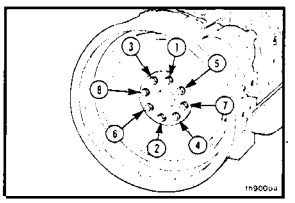
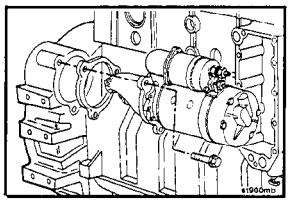
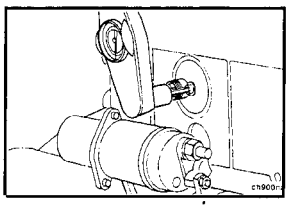
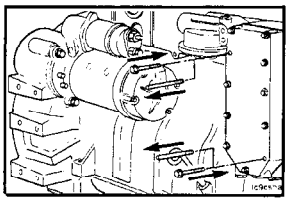
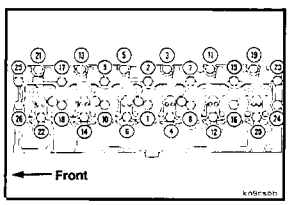
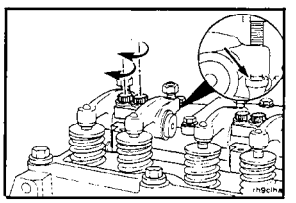
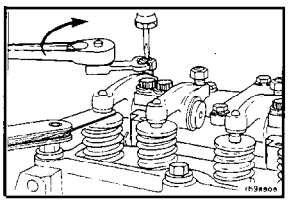
Use Scotch Brite® 7448, or equivalent, to remove small nicks and burrs.

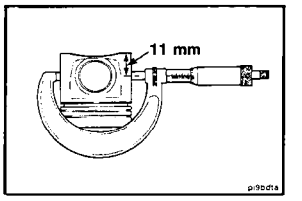
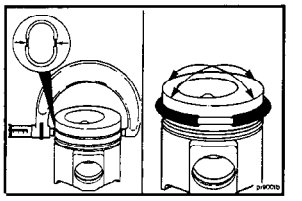
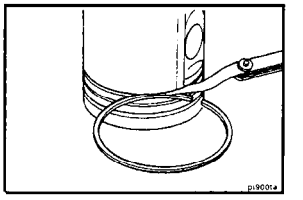
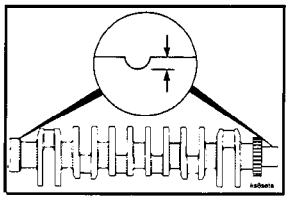
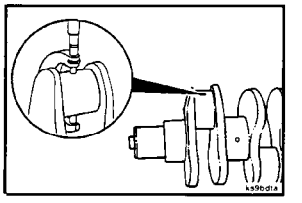
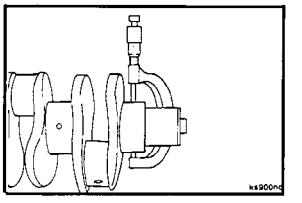
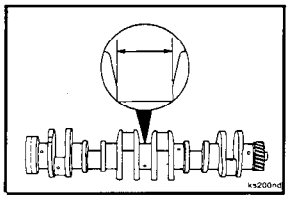


Inspect all threaded capscrew holes for damage.

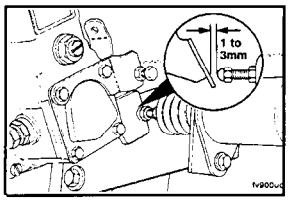
Repair or replace the housing if the capscrew holes are damaged.



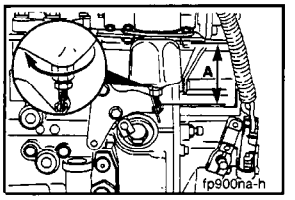
Component or Assembly (Procedure)	Ref.No./Steps	Metric	U.S.	
Flywheel Mounting Capscrews		140 N•m	101 ft-lb	
Starting Motor Mounting Capscrews		77 N•m	57 ft-lb	
Coolant Heater		12 N•m	106 in-lb	
Oil Cooler Mounting Capscrews **Oil Filter Head Mounting Capscrews**		24 N•m 24 N•m	18 ft-lb 18 ft-lb	
Cylinder Head Mounting Capscrews **Note:** Tighten the capscrews in the sequence shown. Start at the center of the cylinder head and alternate toward both ends.	Step 1 2 3	70 N•m (All Capscrews) 145 N•m (Long Only) Rotate 90 Degrees (All Capscrews)	52 ft-lb 105 ft-lb	
Rocker Lever Retaining Clamp Capscrews		55 N•m	41 ft-lb	
Rocker Lever Adjusting Screw Locknut		24 N•m	18 ft-lb	

Component or Assembly (Procedure)	Ref.No./Steps	Metric		U.S.	
Piston Skirt Outside Diameter		113.814 mm 113.886 mm	MIN MAX	4.4810 in 4.4840 in	
Top Ring Groove Keystone Angle Wear Use micrometer and Part No. 3823966.		113.938 mm	MIN	4.4857 in	
Intermediate Ring Groove Keystone Angle Wear Use micrometer and Part No. 3823965.		114.323 mm	MIN	4.5009 in	
Intermediate Rectangular Ring Side Clearance		0.070 mm 0.150 mm	MIN MAX	0.0028 in 0.0059 in	
Oil Control Ring Side Clearance		0.020 mm 0.130 mm	MIN MAX	0.0008 in 0.0051 in	
Crankshaft Oil Seal Wear Groove, Front and Rear		0.025 mm	MAX	0.010 in	
Crankshaft Connecting Rod Journal • Outside Diameter		75.962 mm 76.013 mm	MIN MAX	2.9906 in 2.9926 in	
• Out-of-Round		0.050 mm	MAX	0.0020 in	
• Taper		0.013 mm	MAX	0.0005 in	
Crankshaft Main Bearing Journal • Outside Diameter		97.962 mm 98.031 mm	MIN MAX	3.8568 in 3.8595 in	
• Out-of-Round		0.050 mm	MAX	0.0020 in	
• Taper		0.013 mm	MAX	0.0005 in	
Crankshaft Thrust Face Width (Standard)		42.975 mm 43.076 mm	MIN MAX	1.6919 in 1.6959 in	

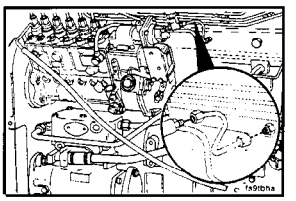
Component or Assembly (Procedure)	Ref.No./Steps	Metric		U.S.
Fuel Shutoff Solenoid Adjustment				
- **Synchro-Start**				
• Plunger Stroke Gap		0.04 mm	MAX	0.118 in
• Plunger Stroke Length		25.4 mm	MAX	1.0 in
- **Trombetta**				
• Plunger Stroke Gap		0.04 mm	MAX	0.118 in
• Plunger Stroke Length		33.3 mm	MAX	1.3 in



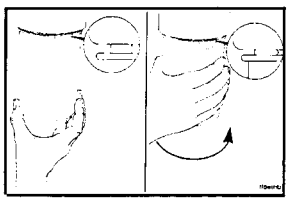
Fuel Shutoff Solenoid Adjustment				
RQVK Governor	A	66.9 mm		2.64 in



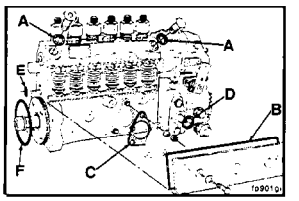
Fuel System Torque Values				
Air Fuel Control (AFC) Fitting		24 N•m		18 ft-lb



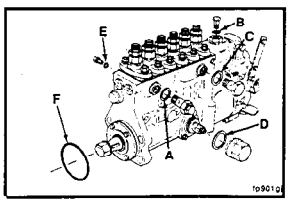
Fuel Filter
Install the filter as specified by the filter manufacturer.



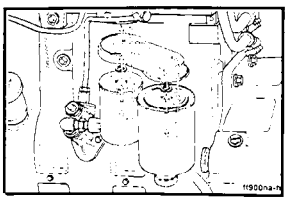
Fuel Injection Pump Sealing Washer				
- **Bosch Pump**				
• Sealing Washer	A	24 N•m		18 ft-lb
• Sealing Washer	D	15 N•m		11 ft-lb

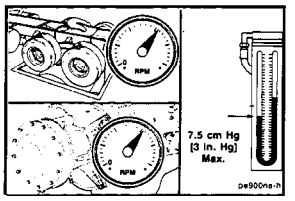
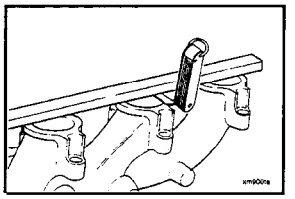
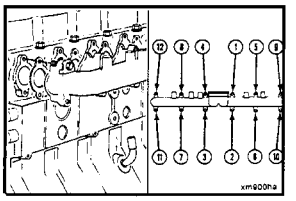
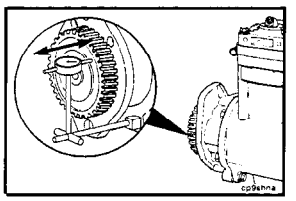
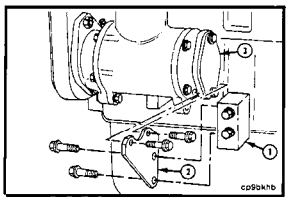
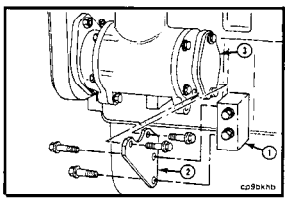
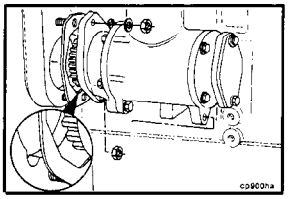


Fuel Injection Pump Sealing Washer				
- **Nippondenso Pump**				
• Sealing Washer	A	24 N•m		18 ft-lb
• Sealing Washer	B	14 N•m		10 ft-lb
• Sealing Washer	C	27 N•m		20 ft-lb
• Sealing Washer	D	70 N•m		50 ft-lb
• Sealing Washer (Bleed Screw)	E	5 N•m		36 in-lb



Fuel Filter Head Adapter		4 N•m		35 in-lb
Fuel Filter Adapter Nut		32 N•m		24 ft-lb



Component or Assembly (Procedure)	Ref.No./Steps	Metric		U.S.	
Exhaust System Specifications					
Exhaust Restriction		7.5 cm Hg	MAX	3.0 in Hg	
Exhaust Manifold Flatness		0.20 mm	MAX	0.008 in	
Exhaust System Torque Values					
Exhaust Manifold Mounting Capscrews:					
• Flanged Head		43 N•m		32 ft-lb	
• Hex Head		43 N•m		32 ft-lb	
Air Compressor Inspection Specifications					
Crankshaft End Clearance					
• **Single Cylinder Air Compressor**		0.05 mm	MIN	0.002 in	
		0.15 mm	MAX	0.006 in	
• **Two Cylinder Air Compressor**		0.05 mm	MIN	0.002 in	
		0.19 mm	MAX	0.008 in	
Note: Specifications and instructions for rebuilding the two cylinder air compressor are provided in the Air Equipment Rebuild Manual, Bulletin Nos. 3810242 and 3810257.					
Air Compressor Torque Values					
Air Compressor Brace to Air Compressor Mounting Capscrews					
Holset		43 N•m		32 ft-lb	
Bendix		43 N•m		32 ft-lb	
Midland		32 N•m		24 ft-lb	
Air Compressor Brace to Cylinder Block Mounting Capscrew		43 N•m		32 ft-lb	
Air Compressor Flange Mounting Nuts					
Nut		77 N•m		57 ft-lb	
Stud to Gear Housing		Hand Tight			

Pipe Plug Torque Values

Size		Torque		Torque	
Thread	Actual Thread O.D.	In Aluminum Components		In Cast Iron or Steel Components	
in	in	N•m	ft-lb	N•m	ft-lb
1/16	0.32	5	45 in-lb	15	10
1/8	0.41	15	10	20	15
1/4	0.54	20	15	25	20
3/8	0.68	25	20	35	25
1/2	0.85	35	25	55	40
3/4	1.05	45	35	75	55
1	1.32	60	45	95	70
1-1/4	1.66	75	55	115	85
1-1/2	1.90	85	65	135	100